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THE

YEAR-BOOK OF FACTS

IN

Science and Art

EXHIBITING

MOST IMPORTANT DISCOVERIES AND IMPROVEMENTS

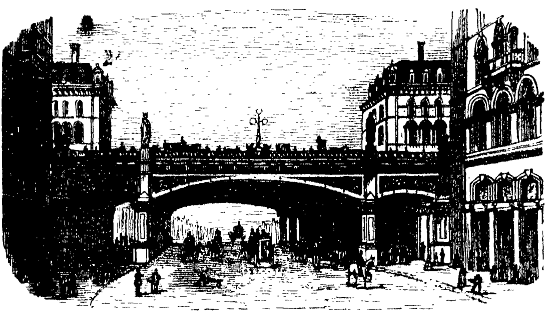
OF THE PAST YEAR

IECHANICS AND THE USEFUL ARTS; NATURAL PHILOSOPHY; LECTRICITY; CHEMISTRY; ZOOLOGY AND BOTANY; GEOLOGY AND MINERALOGY; METEOROLOGY AND ASTRONOMY.

By JOHN TIMBS,

)R OF "CURIOSITIES OF SCIENCE," "THINGS NOT GENERALLY KNOWN," ETC.

hen a great invention is achieved and published for the benefit of the human ıere are always crowds of men ready to exclaim, 'We said that it could be done ıgo,' or 'We were on the very point of announcing a similar discovery.' This e all very true, but the credit is due to him who first has faith enough and works h to produce the desired result."—TIMES, 1869.



Holborn Valley Viaduct—Farringdon Street Bridge. (See p. 9.)

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MR. E. J. REED, C.B.,

CHIEF CONSTRUCTOR OF THE NAVY.

(*With a Portrait.*)

THIS able engineer was born at Sheerness in the Isle of Sheppy, Kent, in 1830. After serving four years of his apprenticeship to the shipbuilding trade in Sheerness Royal Dockyard, he was selected at a competitive examination by the Rev. Canon Moseley, who acted for the Government, to undergo a special training in the School of Mathematics and Naval Construction at Portsmouth, then under the charge of the Rev. Joseph Woolley, LL.D., F.R.A.S. On his appointment, Mr. Reed received the personal thanks of Admiral Price, then Superintendent of the dockyard, for his exemplary conduct during the period of his study at the dockyard school. At the Portsmouth School of Naval Construction Mr. Reed always held a high position; and before the abolition of that school, in 1852, received from Dr. Woolley a special recommendation to Sir F. Baring, then First Lord of the Admiralty, as being peculiarly qualified for advancement in Her Majesty's service. The Ministry of Lord J. Russell resigning, however, at that time, nothing came of this recommendation: and when the late Sir James Graham again became First Lord of the Admiralty, the Portsmouth School, like its predecessor at the same place, was abolished. After serving a year in Sheerness Dockyard as a draughtsman, Mr. Reed, finding that the professional education which he and others had received was of no avail in the only offices then open to them in Her Majesty's service, accepted the editorship of the *Mechanics' Magazine*, which had always had more or less connection with shipbuilding literature, and which, under his management, soon became an authority on questions of Naval Architecture; its articles on that subject being frequently quoted in the House of Commons. It is worthy of remark that when the administration of Admiral Sir Baldwin Walker, the late Surveyor of the Navy, was called in question in Parliament a few years since, the substance of the First Lord of the Admiralty's (Sir C. Wood's) defence was an extract from an article from the pen of Mr. Reed in the publication which he edited, and that defence was accepted by Parliament as virtually sufficient, the subject being at once allowed to drop. Shortly afterwards a paper was read by Mr. Reed at the Society of Arts, then under the presidency of his late Royal Highness the Prince Consort, on "The Modifications which the Ships of the Royal Navy have undergone during the present century in Dimensions, Form, Means of Propulsion, and Powers of Attack and Defence;" and so great was the effect produced by the mass of information accumulated in this paper, and by the arguments which the author adduced in favour of modern improvements and of active

progress in our naval construction, that its statements were cited repeatedly by the most influential journals as authoritative on these points; and the Government placed in Mr. Reed's hands particulars of the French Navy which they had recently received, with the view of bringing about a full understanding respecting the relative strengths of the navies of England, France, and other European Powers. When, three years afterwards, Dr. Woolley, Mr. Scott Russell, and other gentlemen interested in naval architecture, met together to establish the Institution of Naval Architects, Mr. Reed was urgently requested to become the professional Secretary; and after some hesitation he accepted the task. Sir John Pakington, the President of the Institution, and others of its officers, have repeatedly borne public testimony to the efficiency with which this duty was performed, and have attributed much of the success of the Institution to the services of Mr. Reed.

About this time, Mr. Reed first brought before the Admiralty his proposals to reduce the dimensions, cost, and time required for building our iron-clad ships of war; which proposals were received with readiness and confidence by his Grace the Duke of Somerset, the First Lord of the Admiralty; and by Admiral Robinson, Controller of the Navy. Soon after undertaking the conversion of the *Enterprise*, *Research*, *Favourite*, and other small ships into armour-clads, and after designing the iron-clad frigates *Bellerophon*, *Lord Warden*, *Lord Clyde*, and *Pallas*, Mr. Reed was offered and accepted the Chief Constructorship of the Navy. The immediate occasion of his appointment was his compliance with the desire of the Admiralty to increase the armour-plating of a class of frigates with wooden hulls, which were to be built with the express sanction of the House of Commons, and which are now known as the Lord Warden and Lord Clyde class; the object of the Admiralty being to secure, in conjunction with the increased armour, a speed of thirteen knots. This problem had been pronounced impossible by others, and Mr. Reed, who was then engaged upon the *Enterprise*, was requested to solve it if possible. This he engaged to do; and when completed, both ships, with the increased armour upon them, steamed at thirteen knots and a half, thus more than fulfilling the required conditions. It may be observed, in short, that Mr. Reed's avowed principles are to build our war-ships, in these days, quickly, powerfully, and with a careful regard to the constructions of other naval powers, so as to maintain that superior force upon the ocean of which we have for ages been justly proud. But these principles are not associated with any tendency to extravagance; on the contrary, Mr. Reed is pre-eminently the advocate of comparatively small, handy, and economical ships, while he is admitted to have made several important simplifications and economisations in the construction of the largest class of ironclads. His largest frigate, the *Bellerophon*, cost, it is said, 100,000*l.* less than the previous

ship built at Chatham Dockyard, the *Achilles*, and is at the same time a much more formidable vessel.*

During the past year he has sent to sea four ships, each of which is of itself sufficient to signalise the year as one of marked progress in naval construction. These vessels are the *Hercules* and *Monarch*, both iron-clads; and the *Inconstant* and *Volage*, both of which are extremely fast unarmoured ships, designed and built for the protection of our commerce against the depredations of light war-ships and privateers. The *Hercules* is a broadside iron-clad carrying prodigious armour and guns; but, nevertheless, possessing a speed under steam in excess of every iron-clad ship of every nation that preceded her. The *Monarch* is the first sea-going iron-clad turret ship, with a full rig, ever sent to sea by any naval power. She carries armour not greatly inferior to that of the *Hercules*; is armed with guns of even greater power than hers (each weighing twenty-five tons); and is, nevertheless still faster then the *Hercules* herself, exceeding, in fact, upon the measured mile and during a long steaming cruise in the Channel, the fastest mail steamers of the Peninsular and Oriental Company. The third of these remarkable ships is the *Inconstant*. This vessel is without armour, but carries an extremely heavy armament, chiefly consisting of twelve-ton guns, and has a full rig, which enables her to sail at a very high speed under canvass; while under steam she surpasses at half-power the greatest speed ever attained at full power by the fastest unarmoured frigates that preceded her; her own speed at full-power by far exceeding that of every other war-ship, and falling short by only a fraction of a knot of the speeds of the very fleetest mail steamers in the world, viz., the Holyhead and Dublin mail packets. The fourth ship is the *Volage*, which may be briefly described as a small *Inconstant*, and which is second in point of speed to the *Inconstant* herself only.

During the past year in which the Chief Constructor has contributed these unique ships to H.M. Navy, he has found time to write and published two elaborate professional volumes; the first, entitled *Shipbuilding in Iron and Steel*, was published at the beginning of the year, and was at once adopted as the text book in the schools of Naval Architecture at home and abroad It is an elaborate *practical* treatise on iron ship construction, and while describing past systems, sets forth the novel method of framing and plating ships, which the author has himself introduced and perfected during the short period of his service at the Admiralty. The second work of the author, published but a few weeks before this article, is of a more popular character, and sets forth the qualities, performances, and cost of *our Iron-clad Ships*, comprising, also, lengthy chapters upon turret-ships and iron-clad rams. The publication of the latter work—as indeed of the

* These biographical data originally appeared in the *Illustrated London News*, January 6, 1866, accompanying a portrait of Mr. Reed.

former likewise—indicates the fearless spirit in which Mr. Reed fills his extremely responsible position, and shows that he is perfectly prepared to lay before the public not only full descriptions of the works upon which its money is expended, but also the very grounds upon which every ship is designed and built.

But, the most signal proof of the success with which the subject of this sketch has laboured—in spite, we are bound to say, of no little misrepresentation and detraction—is to be found in a very remarkable leading article which appeared in the *Times* of December 30, 1869. This article may be taken as independent evidence upon the point, because it is based upon the evidence of the Secretary to the United States Navy, who cannot be suspected of undue favour to the Navy of this country, or to its architect. The *Times* writes as follows:—

"A certain satisfaction ought undoubtedly to be derived from the official account of the American Navy in our last impression. It is a novelty to find England exhibited to the world as a model of enterprise and success in the matter of Naval Administration. The British Admiralty has not often been complimented either at home or abroad, but here we have the American Secretary repeating, and even magnifying, the recent claims of our First Lord. Mr. Childers was at the pains of explaining last Spring that we really had got a better Fleet than either France or America. Mr. Robeson echoes his words with a will, and declares that one of our new iron-clads would drive any American squadron from its station in a single day. What we used to think of the United States the United States now think of us; what we used to confess with annoyance and vexation they now confess of themselves. . . . . .

"These conclusions of the Americans are founded not so much on the weakness of their own case as the strength of ours. We, it seems, have 'succeeded, by our ingenuity, energy, and liberality, in constructing some beautiful specimens' of fighting ships—ships that, according to our critic's description, could go anywhere and do anything. The British cruiser is a model of strength, swiftness, and security. Our new iron-clad can sail as well as steam, and run as well as fight; they consume very little fuel, they can keep the sea under all circumstances, and they combine the power of a floating battery with the fleetness and smartness of a frigate. A single one of them would be 'a terrible foe,' whereas we are as strong in numbers as in quality. Against the forty-three vessels of the Union, England has 'cruising on the same seas, and with duties not more various and extended, no less than 191 ships, with her flying squadron ready to reinforce her power whenever occasion may require.' Mr. Childers, we think, ought to feel very comfortable as he reads these acknowledgments, and it must be owned that, if we have spent some time and money on our apprenticeship, we seem to have acquired a real mastery over the work at last. One consolation only can Mr. Robeson draw from the existing

state of things, and that is, that the Americans can now have the benefit of our costly experience. His department, he observes, has carefully watched our experiments, and is 'familiar with their details and results, and knows their strength and their weakness.' It will be interesting, therefore, to see what lessons are drawn by such expert and practical authorities, and the conclusions are not a little curious.

"The Americans appear to have given up the turret principle —their own favourite invention—just as we have succeeded in turning it to account. Mr. Robeson condemns the Monitor system altogether, and reiterates with emphasis his preference of the broadside. It is now plainly stated that even the best of the Monitors are but 'steam-batteries, not sea-going cruisers. The utmost that can be said of them is that they may possibly be capable of performing a sea voyage 'under favourable circumstances;' but even then 'they require several vessels to accompany them, and, being entirely without sailing power, must be towed as soon as their coal is exhausted; they would always be dangerous to health in tropical seas, and with broken or disordered machinery they would be helpless in mid-ocean.' The old popular model, therefore, is finally discarded, and Mr. Robeson circumstantially describes its proposed successor. This is to be a broadside vessel, carrying heavy guns, and impervious herself to the heaviest ordnance afloat."

These sentences from the leading journal, and from the American Secretary, although making no personal mention of Mr. Reed, are the most satisfactory evidence of his remarkable success that could well be afforded. They show that through all detraction and opposition he has been building up a most powerful fleet, and one which has already become the admiration of rival powers. It now proves to be a most fortunate circumstance for the country that no agitation—not even the speeches of influential members of Parliament themselves—have succeeded in diverting him from this steady pursuit, or prevailed upon him to enter upon the production of these Monitor ships which are now admitted to be useless for sea-going purposes, and the defects of which are set forth at length in Mr. Reed's last-published book. Nor is the present prestige of our Navy the only advantage gained by the adherence of the Chief Constructor to sound principles of construction combined with rapid progress in guns and armour. The money saving to the country has been enormous, for a very few errors in the design of iron-clad ships would involve us in the loss of millions sterling.

A high career is, in all probability, open to Mr. Reed. Although less than forty years of age, he has effected a complete transformation of the Navy of England. Before the production of his most recent and most important ships, he received the honour of a Civil Companionship of the Bath from the Crown, as a mark of the appreciation in which his services were held; and there is obviously great scope for further distinction in such an office

as that which he holds, and which he is filling so successfully. It must be remembered, however, that the stress which the duties of such an office put upon a man's health and constitution is exceedingly severe, and already Mr. Reed has more than once been compelled to abandon his work for short periods. Let us hope that we may not have to add his name to the list of those public servants whose lives have been sacrificed at an early age to the terrible exactions of modern professional life in these high-pressure days.

It will be interesting to add that frequent overtures have been made to Mr. Reed with the view of inducing him to seek a Parliamentary career, and in 1868 it is understood that he resigned his office with the intention of contesting the Pembroke boroughs. The Admiralty of the day, however, pressed him to remain at his post, and it may now be presumed that the recognised success of the ideas which he has carried out in the Navy, and the consequent decline of Parliamentary opposition to his plans, have removed his chief inducement to abandon his professional work with Parliamentary objects.

The accompanying portrait of Mr. Reed is from a photograph by Mr. Herbert Watkins, of Regent-street, London.

CONTENTS.

THE

YEAR-BOOK OF FACTS.

Mechanical and Useful Arts.

THE HOLBORN VALLEY VIADUCT.

(*See the Vignette.*)

THIS great public improvement has been opened for traffic, though in an incomplete state. It is generally described in the *Year Book of Facts*, 1869, pp. 15–16; so that we shall but briefly (by aid of the *Illustrated London News*) describe the work as executed.

The foundation stone was laid June 3, 1867. The Viaduct itself is 1,400 feet long from end to end, and a little over 80 feet wide, *i.e.*, 50 feet roadway and 15 feet each of the two footways. It forms a gentle curve from the western end of Newgate-street, and is then continued in a straight line to the western side of Farringdon-street, occupying nearly the whole space of Skinner-street and a small portion of St Sepulchre's churchyard. From Farringdon-street westward it is carried by a gentle curve to the end of Hatton Garden, occupying the sites of the houses on the south side of Holborn Hill, the old roadway, and a large part of the churchyard of St. Andrew's.

The Viaduct is built on a double system of arches; those for the roadway are plain, solid, double archways of 24 feet span; and for the footway double cellular arches, 10 feet in diameter; and rising from one to three tiers, according to the dip of the incline. These arches are to be used as cellars to the warehouses built up by the side of the Viaduct.

In front of the cellars, and between them, and beneath the main road on each side, runs a subway along the whole length of the Viaduct. This subway has three rows of brackets for gas-pipes, water-pipes, and telegraphic wires. The sewage is similarly provided for along the centre of the roadway. The brickwork is very massive, in some parts the rings of the arches being eight bricks thick; whereas the Board of Trade exact only five rings of brickwork for a railway arch. The foundations for the masonry were taken down to the London clay and bedded in 4 feet of solid concrete. In some cases more than 30 feet had to be excavated before the clay was reached. The Viaduct is pronounced to be a specimen of engineering skill and good workmanship. But, after all, it is a hidden marvel. What will the world see of it when the houses are built up, except a street above and a bridge or two below?

The Viaduct crosses Farringdon-street obliquely, as did the old line of roadway. Consequently we have a skew bridge, deviating 36 deg. from a right angle. In addition, the raising of

Farringdon-road by a slope from Newcastle-street northwards, gave the ground a visible gradient as it passed under the bridge. Nevertheless, all looks well to the eye now that the work is finished. The bridge is of cast iron, consisting of six double main ribs, connected with bracing-frames and cross-girders, on which are laid corrugated cast-iron plates sustaining the layers of concrete and asphalt, which furnish a foundation for the granite pitching and York paving above, constituting the Viaduct road and footway. The elevation is of three Venetian Gothic arches supported by twelve polished columns of granite and twelve abutment piers. The four external abutment piers are of granite, and the remainder of Portland stone. The twelve granite columns stand six on each side of the roadway, separating the latter from the pavements. The abutment piers project from the walls, the foot-passengers having the abutment piers on one hand and the granite columns on the other. The base of each column is of Cornish granite unpolished. The base moulding is of black Guernsey granite polished. The shaft, 4 ft. 3 in. in diameter, is of polished red Ross of Mull granite. The capitals are of polished Aberdeen granite, ornamented with bronze leaves. The four external piers, above the capital, support each a block of polished Ross of Mull granite, continued up to form a pedestal for a statue. There are four statues—Fine Art, Science, Commerce, and Agriculture. These statues are 8 ft. high, cast in bronze by Messrs. Elkington.

From the surface of Farringdon-street to the top of the pedestals bearing the statues is 31 ft. on the south side. On the north side the altitude is less; but the difference merely affects the height of the base of each column. The minimum head-way under the bridge is 16 ft. next the kerbstones and 21 ft. in the centre. The appendages, together with the statues, give the bridge a very decorative appearance, aided also by the richness of the colouring. At each of the four angles of the bridge are stone staircases, whereby foot-passengers can ascend and descend to and from the Viaduct. The Engineer-in-Chief of this important work is Mr. Haywood.

NEW BLACKFRIARS BRIDGE,

OPENED by Her Majesty the Queen, on the same day with the Viaduct, is described in the *Year Book of Facts*, 1869, pp. 12–13.

THE ISTHMUS OF SUEZ MARITIME CANAL.

THE opening, on November 17, 1869, of the Maritime Canal through the Isthmus of Suez, to connect the Mediterranean with the Red Sea, was the great engineering event of the past year. A procession of ships through the canal and back was the formal ceremony, followed by fêtes and celebrations to a most profuse extent. "Thus," says the *Builder*, "a long-talked of work, of

cosmical importance, has been at last so far accomplished by the cutting through of a narrow neck of land heretofore separating more than one-half of the whole habitable world into two parts, and dividing the ocean on either side of it, so that till now no ship could pass from the Mediterranean arm of the Atlantic Ocean to the Red Sea arm of the Pacific Ocean, without almost circumnavigating the world, whether *viâ* the Cape of Good Hope eastward, or Cape Horn westward." The canal has been opened, it is thought prematurely by some, but there is such a conflict of opinions and multitude of counsels upon the subject that we cannot attempt to unravel them. The history of the great work, of course, remains to be written. In the meantime, the special artist of the *Illustrated London News*, which is pre-eminently distinguished by its illustration of the most important *realities* and living interests of our time, as well as by its pictures of progress in Fine Art, has provided the public with a complete series of engravings of all that belongs to the origin and scenery, design and construction, of this great enterprise. The numbers of that journal from March 13 to April 17, inclusive, and those in November and December, contain maps and plans, and picturesque views, accompanied by descriptive statements, compiled from the most authentic reports, and the pictures were sketched from the objects themselves, so as to leave scarcely any matter of detail unrecorded,—a labour of trustworthiness and completeness deserving of record amongst the highest successes of the above journal, and ranking with its illustrations of the Crimean and Abyssinian Wars.

From these valuable details in the *Illustrated London News* we have selected, as far as our space will permit, the details:— The share capital of the Company engaged in this vast work is eight millions sterling, besides which, four millions sterling have been raised on debentures, and nearly four millions paid by the Viceroy as indemnity for the non-fulfilment of conditions already mentioned, and for the resumption of the lands and fresh-water canal. The contractors for the canal works were Messrs. Borel, Lavalley and Co.; the contractors for the harbour works of Port Saïd were Messrs. Dussaud Brothers; Voisin Bey was the director-general of the works. The line is divided into four sections, of which M. Laroche, M. Gioia, M. Berthoult, and M. Larousse were the respective engineers. M. Lesseps himself, as managing director and president of the company, had the constant superintendence of all its operations.

We now proceed to give a brief outline of this vast scheme. The Maritime Canal extends from the newly-constructed artificial harbour of Port Saïd, on the Pelusian coast of the Mediterranean, to the port of Suez, at the head of the Red Sea. The length of the canal is not quite 100 miles. Its depth throughout is 26 ft.; its general width 246 ft. at the base and 328 feet at the top of the banks, except in some portions of the line, where it is cut through high ground; the width is here reduced to 190 ft. at the

upper part. There are no locks on the Maritime Canal. Vessels will be able to steam through, or be towed through, from sea to sea in about sixteen hours. When the position of a port on the Mediterranean coast for the entrance to the Maritime Canal had to be selected, the difficulty was to find a spot along the shore of the Gulf of Pelusus possessing some advantages for the construction of a harbour. The country on this part of the coast is exceedingly flat. On approaching the sea, large lagoons are seen, formed by the inundations of two branches of the Nile; beyond this a narrow strip of sand, scarcely rising above the sea-level. The difficulties with which science had to contend were the absence of a firm foundation and the encroachment of the silting sand. The reason which led the company's engineer to select the spot which Port Saïd now occupies was that the line of deep water was less distant from the shore at that point—30 ft. of water at 2,870 yards—than at any other point in the Gulf of Pelusus. On leaving Port Saïd the canal enters Lake Menzaleh, through which the channel runs for twenty-nine miles. The waters of this lake are shallow and the bottom composed of mud. At times the sea washes over the strip of sand to the north of the lake. It was found, however, that a firm dry soil was below the mud. Leaving Lake Menzaleh at Kantara, a station on the desert route between Egypt and Syria, the course of the canal for two miles lies through low sand hills. It then enters Lake Ballah, traverses it for a distance of eight miles, and then enters a deep cutting extending from El Ferdane to Lake Timsah. Near El Guisr, four miles south of El Ferdane, the deepest cutting throughout the line had to be excavated, varying from 60 ft. to 70 ft. The characteristics of the first half of the Maritime Canal are that about thirty-four miles of its course lie through lakes, the remainder through elevated plateaux. The second half of the channel, from Ismailia to the Red Sea, divides into two portions: in the first the canal skirts the eastern shore of Lake Timsah and enters the cuttings at Toussoum and Serapeum; in the second it passes through the Bitter Lakes for twenty-four miles, goes through the last cutting at Chalouf, and enters the Red Sea a mile to the south-east of Suez.

On emerging from the Serapeum cutting, the canal takes a central course through the Bitter Lakes. These lakes will eventually be filled mostly from the Mediterranean. The canal then, passing out of the southern extremity of the lesser Bitter Lake, enters the last cutting at Chalouf. The remaining twelve miles to the Red Sea present a continuous level plain slightly above the level of the sea.

The new artificial harbour of Port Said has been constructed by running out into the sea two breakwaters, or moles, which are formed of huge blocks of concrete. Each block measures twelve cubic yards, and weighs twenty-two tons, and is composed of two thirds sand and one-third hydraulic lime. The lime was imported from France; the sand was dredged up in the harbour. Each

block cost about £13. They are not laid as in masonry, but thrown down loosely. The breakwaters are intended to answer the double object of protecting vessels from heavy seas and of arresting the alluvium brought down by the river Nile in its passage towards the Bay of Pelusus, so as to prevent its choking up the channel. The western breakwater extends from the shore 2,400 yards in a straight line towards the north, and then with a slight angle towards the east extends 330 yards further. The eastern breakwater leaves the shore at the distance of 1,530 yards of the commencement of the western breakwater, and extends nearly north for a distance of 2,070 yards, at which point it is 760 yards from the western breakwater, and this distance constitutes the width of the entrance. It will be readily understood from this description that the harbour is well protected from the strong and prevailing north-west winds. The portion of the harbour affording shelter to vessels is nearly 500 acres in extent; and, although the depth of water is not sufficient for the largest men-of-war, it is quite sufficient for ordinary merchantmen, if the present depth be maintained. The prevailing winds being from the north-west, large quantities of alluvium are constantly brought along the shore from the Nile; and Mr. John Fowler, C.E., who examined the canal and harbour works, thinks the western breakwater should be made solid, to prevent the mud and sand from getting through the crevices between the loose blocks, and so choking up the harbour.

The construction of the Fresh-Water Canal forms an interesting chapter in the history of the undertaking. The Nile water, to which Ismailia owes its pleasant gardens, is taken from a branch of the river that flows by Zagazig, the ancient Bubastis, and is brought, partly along the line of the ancient canal of the Pharaohs, to the shores of Lake Timsah. The level of the lake is considerably lower, and, consequently, it was necessary to construct two locks. But the Fresh-Water Canal answers other purposes no less important than the means of transport it affords for machinery and provisions; and a system of pipes conducts the pleasant and wholesome Nile water along the banks of the Maritime Canal as far as its Mediterranean seaport, thus supplying the necessities of more than twenty thousand people. The waterworks themselves, simple and efficient as is the machinery employed, are one large engine of 50-horse power, which pumps 1,500 cubic metres a day into the pipes; and two smaller engines, which are seldom employed, are capable of doubling that amount.

THE AMSTERDAM EXHIBITION.

THE International "Teuteonstelling" of Amsterdam has been opened, the object of the Exhibitors being not so much to introduce novelties as to open up new markets in Holland, and the drawing forth from the neighbouring countries, practical results of what can be done towards producing cheap and useful articles

for the middle and working classes. The following is abridged from the *Times* Report:—

The first six classes into which the exhibits are divided are Building, House Fittings, Clothing, Food, Engineering (as applied to living), and Instruction; while the seventh class is composed of Official Reports on the societies of different countries. Holland, being at home, shows most numerously; and, although she is in many things several years behind her neighbours, there is an air of comfortable solidity about all that she does. In class 1 England is numerically scanty, though good in quality. The huge fireclay draining pipes of Messrs. Cliffe, of Wortley, appeal not only to builders and engineers but to all visitors, who regard them wistfully, as possible preventives of those odoriferous breezes which bring perpetual reminders that Amsterdam is not yet drained. Asphalt roofing is shown by Engert and Rolfe, of London; Gassel, of Bielefield, in Westphalia; and Erichsen, of Copenhagen. In Holland, Lint, of Rotterdam, shows what may be done in architectural decoration with Dutch clinkers alone, and how foundations can be laid with artificial conglomerate. This is of great importance in a country which from end to end has positively no foundation for its building but sand and soft clay, and when we consider that Holland has no building-stone whatever, but that every house is built of brick, while the pavements of the streets come from Belgium, we must not overlook the value of this little bit of brick-wall. Messrs. Maw have a small but choice collection of encaustic tiles, and Messrs. Cliffe some terra cottas of great sharpness of outline. M. Szerelmy, too, shows his Zopissa paper; a pretty and inexpensive wall-paper is exhibited by Klinkaert, of Haarlem, consisting simply of a sheet of white paper, overlaid by a thin black tissue paper cut into wavy lines, and giving the appearance of marble.

Class 2 is largely represented, though in the way of cheap and pretty furniture there is nothing to approach that which is shown in the model cottage from Gothenburg, marvels of workmanship.

Knoblock, of Vienna, shows furniture of a more ambitious kind, but equally cheap. A couple of artistic tastes and limited purse may furnish their drawing-room prettily enough with chairs at 5*s.*, tables and whatnots ranging from 12*s.* to 30*s.*, all made of imitation walnut or rosewood, and of pleasing patterns.

Dutch household articles are cheap and good, and sometimes ingenious. A clever joiner from the Hague has sent a four-post bedstead, the top of which is supplemented by a table. This is brought into play by the legs sliding down inside the posts. The proclivities of the Dutch for comfortable bedding is shown by vast piles of beds, soft and yielding. For the stuffing of these the down of kapok, a fruit from Java, is largely used. It is of silky fibre and extreme lightness. Belge, of Amsterdam, shows a bed with two pillows and mattress, all stuffed with kapok, for 1*l.* 7*s.* 6*d.*, so that cheapness may be added to its

other virtues. But for the benefit of the working classes who cannot afford kapok, Vallencia, of Amsterdam, shows a collection of dried grasses and materials for bed stuffing. For instance, dried sea wrack may be had for 1*d.* a pound; mountain grass for 1½*d.*; while a large bundle of rye straw can be bought for 1*d.*

Class 3 is perhaps the most interesting of the whole, the more so as the exhibitors of gorgeous apparel are few and far between. Among the best English exhibits are Sir E. Armitage's Manchester cloths, Kesselmayer's show of velveteens and trouserings, Hitchcock and Williams in water proof garments; M'Laren, Glasgow, woollen and Shetland goods; Anderson, Limehouse, capes and sou'-westers.

Class 4 is largely exhibited in by all countries. In the English section the food question is principally represented by Messrs. Peek, Frean, and Co., whose biscuits are an institution in Holland; Coleman, M'Call, Batty, &c. Messrs. Caldecote, Raynbird, and Co., of Basingstoke, exhibit a selection of wheats in the ear, and Messrs. Smith, of Edinburgh, a remarkably fine disc of caffeine. Holland shows very well in this class, and particularly in meals, in which a very large trade is carried on.

English furniture is mainly represented by Heal, who shows some cheap hospital bedding, and Peyton, of Birmingham, whose display of bedsteads is very good. In small household articles the principal exhibitor is Kent, who has a large collection of time and labour-saving implements. There is nothing of novelty, though the Dutch visitors are never tired of gazing at the apple-parer or the carpet-sweeper. In candles, however, and paraffines we show well. Craig, of Southwark, has an interesting series of paraffines in different stages of refinement by the La Perouse process, commencing with a lump of buffalo fat from La Plata. James and Son, of Plymouth, show starches, which they guarantee to be as useful for the purposes of food as for washing. In this department, too, is Condy's deodorizing fluid, which ought to have a great demand before it in Holland, supposing always that the Dutch can be brought to the consciousness that their canals are no longer sweet.

NEW CLOCK FOR BEAUVAIS CATHEDRAL.

From a somewhat verbose and stilted description, in the *Petit Journal de Paris*, translated in the *Mechanics' Magazine*, we abridge the following:—

The span of the roof of the Cathedral of Beauvais leaves a space of full 50 yards. This is unfinished, and for 200 years nothing but an ugly wall saluted the eye as a blemish on this colossal monument. To cover this defect the chief inhabitants (to the number of ten) met and clubbed together to place there a Monumental Clock. To accomplish this purpose, money and an horologist were required. The clock-maker was at hand, a fellow townsman who had just finished a splendid work for Besancon. A sum of 1,600*l.* having been collected, the work was

begun. Twenty workmen, ten of whom are clockmakers, in four years, introduced a work composed of 14 different movements consisting of 90,000 pieces, weighing over 35,000 lbs., and costing 5,600*l*., or 4,000*l*. more than the sum first collected. The body of the clock is 36 ft. high, of carved oak, and measures 16 ft. in breadth by nearly nine in depth; the whole is finished in the Byzantine style of decoration. The figure of the Supreme Being from the summit of the clock, at every hour, by a solemn gesture, calls attention to the saints who are at their alcoves yielding attention to the sounds which accompany the crowing of a cock.

The main dial, there are fifty in all, is occupied by the figure of the Saviour enamelled on copper, the largest work in enamel existing; it cost 130*l*. Above their Divine Master the twelve apostles, also in enamel, figure in a circle artistically expressive of devotion. Two hands of steel covered by platinum move over this dial through twenty-four divisions; it is pierced, as are all the others, and shows the pendulum, weighing nearly 1 cwt., which renews its impulse from a steel ball weighing a gramme, or about the thirty-second part of an ounce. This impulse is thoroughly mechanical, and is, as it were, allegorical of the submission of brute force to intelligence. This movement impels the fourteen others, and is wound up weekly, being driven by weights in the usual way. The other dials indicate:—The days of the week. The movements of the planetary bodies. Sun rise. Sun set. The seasons. The signs of the Zodiac. The duration of daylight. The duration of night. The equation of time. The dates. The saints' days. The months. The phases of the moon. The age of the moon. The time at the principal cities of the world. The solstices. The movable feasts. The age of the world. The year of the century. The bissextile years. The longitudes. The number of the century. This portion of the machinery exhibits no indication more than once in 100 years, but nothing more is required than to wind the machine every eighth day. Other dials show further:—The tides. The eclipses for all the world, both total and partial. At the hour when the sun or moon is eclipsed in the heavens, to the minute even, the sun or moon suffers obscuration on the clock. To form a correct appreciation of the enormous work and calculation in this great machine, stated to be unequalled, which has its separate movement from that which shows seconds of time to those which indicate events occurring not oftener than once in 100 years, it must be remembered that three centuries out of four the last year leaps its bissextile. In these years the clock has to leap from February 29, and goes from the 28th to the 1st of March. Here is a movement occurring but once in 400 years. We have here, combined in one harmonious whole, and subjected to uniform direction, 90,000 separate pieces, all uniting to measure and indicate the footsteps of time, showing the positions of the smaller and the greater heavenly bodies in both worlds; even those we see nothing of, which exist in the other hemisphere, and of which this clock faithfully records the rising and setting.

PROGRESS OF MECHANICS.

In the Address of Sir William Armstrong to the Institution of Mechanical Engineers at Newcastle-upon-Tyne, he first pointed out the difficulties under which an inventor laboured a century ago. The workshops of the day could furnish nothing accurately made. There was no such thing to be found as a piston that would fit a cylinder closely enough to let no steam through. It is the steam-engine itself that has given us the perfection of mechanical means. An inventor is now free to design, for he is quite sure that his design can be executed. Thanks to Mr. Whitworth's improvements in machinery, our lathes can produce huge masses of metal turned with such accuracy that nowhere is there a fault equal to the two-thousandth part of an inch. Thanks to Sir William Armstrong himself, a boy may now swing masses weighing many tons from place to place as easily as he could lift a pound weight a few years ago, because since then the hydraulic crane has come into existence. Thanks to the accumulated labours of countless inventors of details, there is no motion so complicated nor design so elaborate but that it can be produced or copied with the greatest fidelity. It is the golden age of Mechanics, and the only danger is lest workmen should forget that their skilled hand labour has been rendered possible by the head labour that preceded it, and that industry alone is no match for combined industry and education.

The unmatched progress of this country during the last century has been due, partly to the natural energy of the race and the narrowness of the bounds within which its increasing families are enclosed, partly to the cheapness of coal. We have little fear that the energy will diminish, but Englishmen would be unwise to conceal from themselves the fact that some of the continental nations are entering the lists with the set purpose of winning if they can. They rest their hopes upon superior education and comparative cheapness of production. If it be true that the British workman undervalues the power of head in competition with hand, he may come to find himself surpassed when he least expects it. If, further, it be true that the supply of coal is likely to diminish in quantity as the mineral itself increases in value, the odds would become too great against British production, and our islands would no longer be able to support the population which now increases annually in spite of emigration.

Sir William Armstrong was the first of late years to draw popular attention to the chances of failure in the supply of coal for manufacturing purposes, and his opinion, as a member of the Royal Commission appointed to investigate the subject, is somewhat reassuring. He concurs with his fellow Commissioners in believing the English stock of coal to be practically inexhaustible, but that is not the whole question. There may be fuel in abundance, but if the price be not such as to enable British manufacturers to compete fairly with foreigners, an apparent plenty

may turn out to be a real want. According to Sir William Armstrong, it would appear that most of our stock of coal lies at great depths below the surface of the ground, and not only has the expense of raising it to the surface to be considered, but also the possibility of working under circumstances yet untried by man. The temperature of the earth at a depth of 980 yards will be equal to blood heat, and if the miners have to penetrate another 500 yards, "mineral substances will be too hot for the naked skin to touch with impunity." Under such conditions human labour would become almost impossible, or, at least, very much restricted in its powers.

But even then there seems no reason to despair. The same necessity which introduced machinery in the factories and the fields may introduce it also in the mines. The race for economy may demand exceptional measures, but if so, we have no reason to suppose that means will not be found to bring coal cheaply to the surface of the earth. When an agent more powerful than the hand of man was wanted to supply man's necessities, the agent was found and brought under subjection by Watt. A long chain of possibilities hung upon that new power, for, as Sir William Armstrong said, "First came the steam-engine, then the great steam-ship, and finally the Atlantic Cable, which without the aid of steam could never have been laid." While we are thoroughly desirous that the importance of a possible failure or reduction in our coal supply should not be lightly passed over, we cannot share the views of those who are inclined to take a despairing view of the future. The rays that shone upon the plants whence, in the form of wood or crushed into coal, men now draw their supply of heat have shone also on the whole surface of the globe; and if it should indeed come to pass that our supplies of one mineral should fail, we have little doubt that another will be found to take its place, or, finally, we must call upon the science which found us electricity to find us some other available source of power. Coal-cutting machines are already taking the place of hand labour in mines, horses are being superseded by hauling machines, and the increasing extent of mines is drawing forth increasing means of ventilation. There is time enough and to spare for the intelligence of men to seek and find means hitherto uncontemplated for the subjugation of nature.

It was not to be supposed that an artillerist of Sir William Armstrong's reputation would let slip an opportunity for pointing to the extraordinary progress of England in this branch of the military art. Ten years ago, when the members of the Institution of Mechanical Engineers met in Newcastle, they were shown some small breechloading rifled guns as curiosities. Since then our artillery has been supplied with 600-pounders, and the Moncrieff carriage has added one more triumph to the engineering art of England. The gunpowder question has not escaped Sir William's attention, and he was able to point to an instrument for detecting slight variations of pressure within the bore of a gun invented

by Captain Noble, a partner in the Elswick firm. It is gratifying to know that the progress in this direction adds more to the powers of defence than to those of attack. Mr. Rendel's famous little gun-boat, the Staunch, has supplied a model for cheap floating gun-batteries, and, in conjunction with torpedoes and quickly made Moncrieff batteries, would render the raids of an enemy upon our rich commercial ports so dangerous as to be highly improbable. We heartily echo the words of our great artillerist,—"The tendency of mechanical invention, as applied to war, is to discourage aggression and thus to maintain peace. We may, consequently, hope that it will hasten the arrival of a period when civilized nations will abandon the arbitrament of arms, and settle their differences by rational and peaceable methods."—*Times.*

RECENT PROGRESS OF MECHANICAL SCIENCE.

In the Section of Mechanical Science at the British Association, the President, Mr. C. W. Siemens, has delivered the inaugural address, which commenced by referring to the important question of Technical Education. He said the great International Exhibition had proved that, although England still holds her ground as the leading manufacturing country, the nations of the Continent have made great strides to dispute her pre-eminence in several branches, a result which is generally ascribed to their superior system of technical education. He thought all would agree in the necessity of steps being taken to promote the work of universal education, although he, for one, thought that objection may be made against the plan of merely imitating the example of our neighbours. The Polytechnic Schools of the Continent, not satisfied to impart to the technical students a good knowledge of mathematics and of natural sciences, pretend also to superadd the practical information necessary to constitute them engineers or manufacturers. This practical information is conveyed to them by professors lacking themselves practical experience, and tends to engender in the students a dogmatical conceit, which is likely to stand in the way of originality in the adaptation of new means to new ends in their future career. On this account the President should prefer to see a sound "fundamental" education, comprising mathematics, dynamics, chemistry, geology, and physical science, with a sketch only of the technical arts, followed up by professional training such as can only be obtained in the workshop, the office, or the field. The interest evinced throughout the country in the work of education, by Parliamentary inquiries, by the erection of colleges and professorships, and by the munificence of a leading member of this section in endowing a hundred scholarships, are proofs that England intends to hold her place in this question of education amongst the civilised nations, and he was confident that she will accomplish this object in a manner in unison with her practical tendencies and independence

of character. He next adverted to the Patent Laws, pointing out their important bearing on the progress of arts and manufactures, and combating the views of those who advocated their entire abolition.

He then proceeded to notice the latest achievements of engineering science, the great Pacific Railway, which joins California with the Atlantic States of the American Republic, and the Suez Shipping Canal (which has since been opened to the commerce of the world). Telegraphic communication with America has been rendered more secure against interruption by the submersion of the French Transatlantic Cable. Telegraphic communication with India still remains in a very unsatisfactory condition, owing to imperfect lines and divided administration. To supply a remedy for this public evil, the Indo-European Telegraph Company will shortly open its special lines for Indian correspondence. In Northern Russia the construction of a land line is far advanced to connect St. Petersburgh with the mouth of the Amour River, on completion of which only a submarine link between the Amour and San Francisco will be wanting to complete the telegraphic girdle round the earth.

But, while great works have to be carried out in distant parts, still more remains to be accomplished nearer home. It is one of the questions of the day to decide by which plan the British Channel is to be crossed, to relieve the unfortunate traveller to the Continent of the discomfort and delay inseparable from the existing arrangements. Considering that this question has been taken up by some of our leading engineers, and is also entertained by the two interested Governments, we may look forward to its speedy and satisfactory solution. So long as the attention of railway engineers was confined to the construction of main lines, it was necessary for them to provide for a heavy traffic and high speeds, and these desiderata are best met by a level permanent way, by easy curves and heavy rails of the strongest possible materials, namely, cast steel; but in extending the system to the corners of the earth, cheapness of construction and maintenances for a moderate speed and a moderate amount of traffic become a matter of necessity. Instead of plunging through hill and mountain, and of crossing and recrossing rivers by a series of monumental works, the modern railway passes in zig-zag up the steep incline, and conforms to the windings of the narrow gorge; it can only be worked by light rolling stock of flexible construction, furnished with increased power of adhesion and great brake-power. Yet, by the aid of the electric telegraph in regulating the progress of each train, the number of trains may be so increased as to produce, nevertheless, a large aggregate of traffic; and it is held by some that our trunk lines even would be worked more advantageously by light rolling stock. The brake-power on several of the French and Spanish railways has been greatly increased by an ingenious arrangement, conceived by Monsieur Lechatelier, of applying what has been termed "contre vapeur,"

to the engine, converting it, for the time being, into a pump forcing steam and water into the boiler.

The President then adverted to the Armstrong gun, the Whitworth bolt, and the defensive armour to resist them, in turn defeated by the hardened shot of Palliser or Grüson. The ram of war with heavy iron sides, which, a few years since, was thought the most formidable, as it certainly was the most costly, weapon ever devised, is already being superseded by vessels of the "Captain" type, as designed by Captain Coles, and carried out by Messrs. Laird Bros.; with turrets (armed with guns of gigantic power) that resist the heaviest firing, both on account of their thickness and of the angular direction in which the shot is likely to strike. By an ingenious device Captain Moncrieff lowers his gun upon its rocking carriage after firing, and thereby does away with embrasures (the weak places in protective works), while at the same time he gains the advantage of reloading his gun in comparative safety. While science and mechanical skill combine to produce these wondrous results, the germs of further and still greater achievements are matured in our mechanical workshops, in our forges, and in our metallurgical smelting works. Here a great revolution of our constructive art has been prepared by the production, in large quantities and at moderate cost, of a material of more than twice the strength of iron, which, instead of being fibrous, has its full strength in every direction, and which can be modulated to every degree of ductility, approaching the hardness of the diamond on the one hand and the proverbial toughness of leather on the other. To call this material cast-steel seems to attribute to it brittleness and uncertainty of temper, which, however, are not its necessary characteristics. This new material, as prepared for constructive purposes, may indeed be both hard and tough, as is illustrated by the hard steel rope that has so materially contributed to the practical success of steam ploughing.

Machinery-steel has gradually come into use since about 1850, when Krupp (of Essen) commenced to supply large ingots that were shaped into railway tyres, axles, cannon, &c., by melting steel in halls containing hundreds of melting crucibles. The Bessemer process, in dispensing with the process of puddling, and in utilizing the carbon contained in the pig iron, to effect the fusion of the final metal, has given a vast extension to the application of cast steel for railway bars, tyres, boiler plates, &c. This process is limited, however, in its application to superior brands of pig iron, containing much carbon and no sulphur or phosphorus, which latter impurities are so destructive to the qualities of steel. The puddling process has still to be resorted to, unless the process of decarburization by Mr. Heaton takes its place, to purify those inferior pig irons which constitute the bulk of our production; and the puddled iron cannot be brought to the condition of cast steel except through the process of fusion. This fusion is accomplished successfully in masses of from three

to five tons, on the open bed of a regenerative gas furnace, at the Landore Siemens Steel-works, and at other places. At the same works cast-steel is also produced, to a limited extent as yet, from iron ore, which, being operated upon in large masses, is reduced to the metallic state and liquefied by the aid of a certain proportion of pig metal. The regenerative gas furnace, the application of which to glass houses, to forges, &c., has made considerable progress, is well suited for these operations, because it combines an intensity of heat, limited only by the point of fusion of the most refractory material, with extreme mildness of draught and chemical neutrality of flame.

These, and other processes of recent origin, tend towards the production, at a comparatively cheap rate, of a high-class material, that must supersede iron for almost all structural purposes. As yet engineers hesitate, and very properly so, to construct their bridges, their vessels, and their rolling stock of the material produced by these processes, because no exhaustive experiments have been published as yet, fixing the limit to which they may safely be loaded in extension, in compression, and in torsion, and because, as yet, no sufficient information has been obtained regarding the tests by which their quality can best be ascertained. This want is in the way of being supplied by the experimental researches that have been carried on for some time at the dockyards at Woolwich: the results of Mr. Whitworth's experiments, tending to render the hammer and the rolls obsolete by forcing cast-steel, while in a semi-fluid state, into strong iron moulds by hydraulic pressure, are looked upon with great interest. But, assuming that the new building material has been reduced to the utmost degree of uniformity and cheapness, and that its limits of strength are ascertained, there remains still the task for the civil and mechanical engineer to prepare designs suitable for the development of its peculiar qualities. In constructing works in foreign parts the reduced cost of carriage furnishes also a powerful argument in favour of the stronger material, although its first cost per ton might largely exceed that of iron.

The inquiries of the Royal Coal Commission into the extent and management of our coal fields appear to be re-assuring as regards the danger of their becoming soon exhausted. Nevertheless the importance of economizing these precious deposits in the production of steam-power, in metallurgical operations, and in domestic use, can hardly be over-estimated. The calorific power residing in a pound of coal, of a given analysis, can now be accurately expressed in units of heat, which, again, are represented by equivalent units of force or of chemical action; therefore, if we ascertain the consumption of coal of a steam-engine or of a furnace employed in metallurgical operations, we are able to tell, by the light of physical science, what proportion of the heat of combustion is utilized and what proportion is lost. Having arrived at this point, we can also trace the chan-

nels through which loss takes place, and in diminishing these, by judicious improvement we shall more and more approach those standards of ultimate perfection which we can never reach, but which we should nevertheless keep steadfastly before our eyes. Thus, a pound of ordinary coal is capable of producing 12,000 (Fahr.) units of heat, which equal 2,240,000 foot lb. or units of force, whereas the very best performances of our pumping-engines do not exceed the limit of 1,000,000 foot lb. of force per pound of coal consumed. In like manner 1 lb. of coal should be capable of heating 33 lb. of iron to the welding point of say 3,000° (Fahr.), whereas, in an ordinary furnace, not 2 lb. of iron are so heated with 1 lb. of coal. These figures show the field for further improvement that lies yet before us. Although heat may be said to be the moving principle by which all things in nature are accomplished, an excess of it is not only hurtful to some of our processes, such as brewing, and destructive to our nutriments, but to those living in hot climates or sitting in crowded rooms, an excess of temperature is as great a source of discomfort as excessive cold can be. Why then should we not resort to refrigeration in summer as well as to calorification in winter, if it can be shown that the one can be done at nearly the same cost as the other? So long as we rely for refrigeration upon our ice-cellars, or upon importation of ice from distant parts, we shall have to look upon refrigeration as a costly luxury only; but the President expresses his belief that by the use of properly constructed machines it will be possible to produce refrigeration at an extremely moderate expenditure of fuel and labour. A machine has already been constructed capable of producing 9 lb. of ice (or its equivalent) for 1 lb. of coal, whereas the equivalent values of positive heat developed in the combustion of 1 lb. of coal, and of negative heat residing in 1 lb of ice, is about as 12,000 to 170, or as 70 to 1. This result justifies the employment of refrigerating machines upon a large scale; but it is hard to say what results may yet be reached with an improved machine on strictly dynamical principles, because such a machine seems not tied in its results to any definite theoretical limits. In changing, for example, a pound of water from the liquid into the gaseous state, a given number of units of heat are required, that may be produced by combustion of coal or by the expenditure of force; but in changing the same pound of water into ice, heat is not lost but gained in the operation, which heat must be traceable to another part of the machine, either as sensible heat or as developed force.

LAW OF PATENTS.

In the year 1868 there were 3,991 applications for letters patent; 2,490 were passed thereon, and 2,456 specifications were filed; 1,501 applications lapsed or were forfeited in the year through the applicants failing to proceed for their patents within the six

months of protection, and 34 patents became void through neglect to file specifications. With regard to the older patents it appears that 13,101 bear date between the 1st of October, 1852, and the 31st of December, 1858. The additional progressive stamp duty of 50*l.* was paid at the end of the third year on 3,692 of that number, and 9,409 became void. The additional progressive stamp duty of 100*l.* was paid at the end of the seventh year on 1,274 of the 3,692 remaining in force at the end of the third year, and 2,418 became void. Consequently about 70 per cent. of the 13,101 patents became void at the end of the third year, and about 90 per cent. became void at the end of the seventh year. The proportionate number of patents becoming void by reason of non-payment continues nearly the same to the present time. In the year 1868 the stamp duties received in respect of patents amounted to 119,271*l.* The fees to the Attorney-General and Solicitor-General for England, and to their clerks, absorbed 11,915*l.* The Attorney-General and Solicitor-General for Ireland receive 2,000*l.* as compensation, and the Lord Advocate 850*l.* The Patent-office establishment takes 9,882*l.*; the printers, 17,677*l.* There are other items of expenditure, but the surplus is very large, and the aggregate surplus income from 1852 to the end of the year 1868 exceeds 726,000*l.* The Commissioners repeat in their report this year that the building devoted to the purposes of the Patent-office is not, and never can be made, suitable for the requirements of the office. They add that the building is now filled, and there is a continual increase of specifications and scientific works, for which provision must be made. Complete sets of the Commissioners of Patents' publications, each set including more than 2,500 volumes, have been presented to the most important towns in the kingdom, to be accessible to the public daily free of charge; and complete series of abridgments or abstracts of specifications have been presented to a large nnmber of literary institutions.

Much interest has been excited among inventors by the proposal which has been mooted in Parliament to abolish the Patent Law. But the general conclusion arrived at is that, although the law as it stands requires great amendment, the refusal to grant a copyright in inventions would give a heavy blow to our national prosperity by terminating the motive to originate new improvements, unless they were of such a nature that they could be worked secretly. All patents which are worth anything have been brought to a successful result only after great labour and expenditure, and there are no inducements to incur these if the inventor is to obtain no benefit from them. The remedy for the objections which have been brought against the existing system of patents is to be found, not by terminating the motive to inaugurate improvements, but by granting patents only for such things as are really new and useful, and which should be determined by competent examiners in every department of the arts.—*Illustrated London News.*

DECIMAL COINAGE AND THE METRIC SYSTEM.

The Second Report of the Standards Commission states that in the unanimous opinion of the Commissioners the time has arrived when the law should provide, and facilities be afforded by the Government, for the introduction and use of metric weights and measures in the United Kingdom. For this object metric standards, accurately verified in relation to the primary metric standards at Paris, and deposited in the Standards Department of the Board of Trade, should be legalised; and verified copies of the official metric standards should be provided by the local authorities for inspectors of such districts as may require them. The Commissioners think that the French nomenclature, as well as decimal scale of the metric system, should be introduced in this country, but they are of opinion that the general introduction of the metric system should be permissive only, and not made compulsory by law after any period to be now specified, so far as relates to the use of metric weights and measures for weighing and measuring goods for sale or conveyance. Considering that during the concurrent use of the metric and imperial systems, it will be expedient to prevent as far as possible imperial and metric weights and measures being accidentally or fraudulently substituted for each other, the Commissioners are of opinion that authoritative regulations should be established under which each series may be readily and easily distinguished, by the adoption of conspicuous distinctive forms or marks for the several weights and measures, and by such other mode as may be determined upon after due inquiry. It is thought expedient that customs duties should be allowed to be levied by metric weight and measure as well as by imperial weight and measure; that the use of the metric system, concurrently with the imperial system, should be adopted by other public departments, especially the Post Office, and in the publication of the principal results of the statistics of the Board of Trade, as well as for the admeasurement and registration of the tonnage of shipping. As to decimal coinage, the Commissioners say that, even if the difficulties of establishing an international unit of coinage cannot be at present overcome, yet the decimalisation of our system of coinage, which is in the power of the Government, would be very useful to the public.—*Illustrated London News.*

PREMIUMS OFFERED BY THE INSTITUTION OF CIVIL ENGINEERS.

The Council of the Institution of Civil Engineers invite communications on various subjects, such as, first, authentic details of the progress of any work in civil engineering, as far as absolutely executed (Smeaton's account of the Eddystone Lighthouse may be taken as an example); second, descriptions of engines and machines of various kinds; or third, practical essays on subjects connected with engineering, as, for instance, metal-

lurgy. For approved original communications, the Council will be prepared to award the premiums arising out of special funds devoted for the purpose, and they have published a list of subjects on which they specially invite communication. This, we believe, may be obtained at the Institution. The Council have awarded the following premiums:—

1. A Telford medal, and a Telford premium, in books, to M. Jules Gaudard, C.E., Lausanne, for paper "On the Present State of Knowledge as to the Strength and Resistance of Materials." 2. A Telford medal, and a Telford premium, in books, to William Shelford, for paper "On the Outfall of the River Humber." 3. A Watt medal, and a Telford premium, in books, to Zerah Colburn, for paper "On American Locomotives, and Rolling Stock." 4. A Telford medal, and a Telford premium, in books, to Thomas Nesham Kirkham, for paper "On Experiments on the Standards of Comparison employed for Testing the Illuminating Power of Coal Gas." 5. A Telford medal, and a Telford premium, in books, to John Ellacott, for "Description of the Low-water Basin at Birkenhead." 6. A Telford medal, and a Telford premium, in books, to Professor Ansted, for paper "On the Lagoons and Marshes of certain parts of the Shores of the Mediterranean." 7. A Telford premium, in books, to William Henry Wheeler, for "Description of the River Witham and its Estuary, and of the various Works carried out in connection therewith, for the Drainage of the Fens, and the Improvement of the Navigation." 8. A Telford premium, in books, to James Robert Moss, for paper "On the Mauritius Railways." 9. A Telford premium, in books, to Imrie Bell, for paper "On Sinking Wells for the Foundations of the Piers of the Bridge over the River Jumna." 10. A Telford premium, in books, to John Milroy, for "Description of Apparatus for Excavating under Water, and for Sinking Cylinders." 11. A Telford premium, in books, to Samuel Parker Bidder, jun., for paper "On Machines employed in Working and Breaking-down Coal, so as to avoid the use of Gunpowder." 12. A Telford premium, in books, to Charles John Chubb, for paper "Coal-getting Machinery as a Substitute for the use of Gunpowder." 13. The Manby premium, in books, to David Marr Henderson, for paper "On Lighthouse Apparatus and Lanterns."

NEW CONSTRUCTION.

An English inventor has built some houses on a novel principle at New Hampton. These houses, says the *Scientific American*, are of a cheap order, designed for labourers. He compresses straw into slabs, soaks them in a solution of flint, to render them fire-proof, coats the two sides with a kind of cement or concrete; and of these slabs the cottages are built. By ingenious contrivance, the quantity of joiners' work is much reduced, and the chimney is so constructed as to secure warmth

with the smallest consumption of fuel, and at the same time to heat a drying closet. The cost of a single cottage of this description, combining "all the requirements of health, decency, and comfort," is 85*l.*

ENGINEERING IN ABYSSINIA.

In the new series of papers by the Royal Engineers, is a Report by Lieut.-Col. St. Clair Watkins, R.E., giving an account of the operations of the engineer department in Abyssinia, with details of all the works executed, accompanied by plans of the port, coast, depôts, camp of Zoolla, and the railway line. A stone pier, jutting out 900 ft. into the sea, with a tramway on it, and on to the beach beyond, to facilitate the landing of the army and its stores; a road 50 ft. wide through the jungle from this pier to the camp, 1¼ mile distant; the cleansing of the old village wells, and the construction of twenty new ones, for the watering of 2,000 men and 2,000 animals; a large store-shed; and a water-shoot about half the length of the pier, raised on trestles above the sea, for conveying to the shore sweet water condensed by H.M.S. *Satellite*, were among the first works executed, and are minutely described here. Lieut.-Col. Watkins states that the difficulties of constructing a railway with unprofessional labour were enhanced by the fact of five different descriptions of rails being sent out, calling for four different modes of fixing, and that five out of ten of the fish-plate holes did not fit those on the rails. After this harassing experience, he comes to the conclusion that railways required for the operations of war should be carried out as a civil work, by engineers and contractors, who make it their business to construct them. An estimate by a contractor was given for this railway at 72,000*l.*, exclusive of rails and plant. The cost, as incurred by the Royal Engineers, was 6,000*l.*, exclusive of rails and plant. Out of this large margin the contractors would have had to supply labour and superintendence. The second Abyssinian paper relates only to the position and leading features of Magdala and its construction. Lieut. T. J. Willans describes one entrance into the place as a small double-storied hut, built of stone and mud, in which was a stout timber door, 4 ft. wide only, with a window over it for the defenders to guard it from; but the dwellings seem to have been built exclusively of wicker work and thatch.

EAST LONDON WATER SUPPLY.

Mr. Woodward (of the British Museum) has based a communication to the British Association upon observations made during the formation of new reservoirs and filtering-beds by the East London Waterworks Company. Two new reservoirs are now being made, covering 120 acres in extent, and of an average depth of 10 ft. The "puddle walls" are excavated to a depth of about 25 ft. The materials removed are all of post-tertiary age,

consisting of surface soil, loamy clay, peat, shell, marl, coarse and fine sands, rounded and sub-angular gravels from the chalk and Woolwich series, with pebbles of chert and sandstone from the older rocks. The deposit is rich in vegetable remains, the peat attaining a thickness of three feet, and containing evidences of the oak, the alder, the hazel, and other trees and plants. The shell marl is at places equally thick, and is rich in shells, 26 species having been determined by the author. The bivalve shells are still united, and the *paludinæ*, &c., have their opercula still in place. Of the animals may be mentioned human remains and works of art of the stone and bronze and of the iron age. The wolf, the fox, the beaver, horse, wild boar, red deer, roebuck, fallow deer, reindeer, the elk, the goat, three oxen (including *bos primigenius*, *bos longifrons*, and *bos frontosus*). The sea-eagle and some fish remains to complete the list. In the deep trenches of the puddle walls tusks of the mammoth and horns of the gigantic *bos* and *cervus* have been found. Mr. A. W. Franks, F.S.A., Keeper of the Ethnographical Collections in the British Museum, has obtained from this deposit a flint scraper, two bronze spear-heads, one bronze arrow-head, one bronze knife, an iron sword (late Celtic), bronze sheath, a Kimmeridge clay armlet, a pierced axe-head of stag's horn, a bone knife, a stag's horn club, various earthen pots (some hand-made and some turned on the wheel), besides many cut bones. In 1743 Bowen's map shows this tract under forest, and in 1300 all Essex was one vast forest. In 1154 the forest of Middlesex commenced at Houndsditch, and extended north and east for many miles, and the forest is described as abounding in wolves, wild boars, stags, and wild bulls. The Walthamstow marshes have not been disafforested more than 100 years. Of the antiquity of these deposits no doubt can exist, for the presence of the reindeer, the elk (determined by Professor Owen), and the beaver is conclusive. Their preservation so near the surface is entirely due to the protective influence of forest vegetation, which has precluded the inroads of agriculture. Mr. Woodward expressed his belief that the deposits indicated, at places, the effects of beaver-works, tracts of forest having been submerged and destroyed by the action of beaver-dams.

CHANNEL RAILWAY.

Mr. Bateman, C.E., has described to the British Association a cast-iron tube which he suggested should be laid down for railway purposes between England and France. He stated that it was the joint design of himself and Monsieur Revy, an engineer of Vienna. The tube would be commenced at one side of the Channel, and would be laid at the bottom of the sea, being built up inside a horizontal cylinder or bell, which would be constantly pushed forward as the building up of the tube proceeded. The line selected for the tube to be thus submerged would be close to Dover on the English side of the Channel, and would extend to

Cape Grisnez on the French coast, the distance between the two points being twenty-two miles, and the average depth of water 110 ft. Mr. Bateman stated that the tube would be made large enough for the passage of carriages of ordinary construction, whilst the traffic was proposed to be worked by pneumatic pressure, thus securing a constant supply of pure air, and at the same time precluding the possibility of a collision. He estimated that a slow train would be able to accomplish the distance in one hour and six minutes, but an express train would go through with ease in forty-five minutes. Five thousand passengers and 10,000 tons of goods could be conveyed through the tube daily. The estimated cost of the whole project was eight millions sterling, the annual working expenses being put down at £150,000. The discussion showed the general opinion of the section to be that Mr. Bateman's plan was the best yet proposed. Mr. Bidder, C.E, had some doubt as to the sufficiency of the estimate, but Mr. Bateman was certain it was enough. The work would take five years to accomplish.

A Correspondent of the *Mechanics' Magazine* enumerates the projects which have been propounded at different times for the construction of a tunnel connecting England and France, and of which there are eighteen in all. The authors of these projects and the dates of their promulgation are as follow:—Mathieu, 1801; Franchet and Mottray, 1803; De la Haye, 1845; Horeau, 1851; Payerne, 1855; Faure, 1855; Wytson, 1855; Nichol, 1856; Vacherot, 1856; Austen, 1856; Turner, 1856; Thomé de Gamond Smith, 1861; Chalmers, 1861; Remington, 1863; Hawkshaw, 1864; Bateman, 1869; Marsden, 1869.

FAIRLIE'S STEAM-CARRIAGE.

On several occasions the principles of the double-bogie engines and light carriages for railways, advocated and developed with so much perseverance by Mr. Fairlie, have been favourably criticised; and recently there was a successful public exhibition of a light Steam-carriage for branch lines and lines of small traffic. The length of the carriage is 43 ft., including a compartment for the guard; the engine, carriage, and framing complete weighs, exclusive of passengers, 13½ tons; and including its load of sixty-six passengers (sixteen first-class and fifty second), only 18½ tons. When entirely completed it will have a broad step or platform on each side, extending its entire length, and protected by a hand-rail, to enable the guard to pass completely round the train. Passengers can also pass along it to the guard, affording thus an easy means of intercommunication. The engine, running on two pairs of small wheels close together, so as to give the smallest amount of wheel base, forms one bogie, or platform, upon which the front part of the passenger-carriage is supported and pivoted, this carriage having another bogie or platform, to which it is also pivoted, supporting its rear end. There is thus

a large freedom of motion, and it was astonishing to witness the speed and grace with which this long body was swung at more than eighteen miles an hour round curves of only 40 ft. upon an oval line of rails under 200 yards in circumference, laid down in a garden attached to the Hatcham Ironworks. Mr. Samuel—the pioneer of light engines and rolling-stock—had many years ago a small engine-carriage running with great success upon the Great Eastern Railway; and numbers well remember the Express. Mr. Fairlie himself has built an engine for the narrowest gauge passenger railway in existence worked by locomotives, which, under the title of the "Little Wonder," has earned a notoriety for itself upon the Festiniog Railway; but never before has the world seen a railway carriage of such large dimensions, with sixty-six passengers, spun round at railway pace in a metropolitan plot of ground of less than three quarters of an acre. From accidental circumstances the present carriage is not of the standard dimensions proposed by that engineer—namely, a carriage with two first-class compartments to seat sixteen persons, three second-class for thirty, and four and a half third-class compartments to seat fifty-four—in all one hundred passengers. The standard machine complete would weigh about 14 tons, and with the passengers from 20 to 21 tons, and could be driven forty miles an hour up gradients of 1 in 100, passing round curves of 50 ft. radius at half that speed with perfect safety, as was recently done upon a temporary line of rails. In fact, as to the safety of running these carriages, there is no question whatever. The weight per wheel of the Fairlie steam-carriage is only about 2½ tons, and it follows, therefore, that very light rails may be used, and everything light in proportion; whilst the capability of passing such sharp curves would also be a very important element in the construction of cheap lines.—*Illustrated London News.*

THE GREAT SKELTON VIADUCT.

THIS vast structure, which carries the new line of the North-Eastern Company from Hull to Doncaster (Staddlethorpe and Thorne) over the Ouse (engineer, Mr. T. E. Harrison), is one of the greatest engineering achievements of the age. Not only did the foundations present almost insuperable difficulties, but the superstructure presents extraordinary features. The comparatively low level of the new line necessitated an opening bridge, and the movable portion so provided for the accommodation of the river traffic is the longest of any work of the kind in England. At the point of crossing the Ouse is about 800 ft. wide, and the movable part of the over-channel bridge is not less than 232 ft. This immense length crosses the deepest part of the river, and turns on a stupendous mid-river pier, and is opened and closed at will, hydraulic power being applied. The most complete signalling has been provided to guard against possible accident to trains while the bridge is open for the pas-

sage of ships. The entire structure is carried by seven spans of solid fish-backed girders resting upon massive iron piers forced to a great depth into the river bed through various layers of river silt, peat, and clay.

THE TOWER SUBWAY.

Amongst the many great improvements now going on in London to relieve the overcrowded state of traffic, and for opening up new means of communication, the Tower Subway is one which deserves especial notice, as forming an easy and safe connection between the two densely populated districts situated north and south of the Thames, between London Bridge and the Thames Tunnel. This work is now in course of construction under the bed of the river, from Tower Hill to Tooley Street, and consists of a tunnel less than a quarter of a mile in length, access being gained to it by a shaft at each end. The depth of these shafts will be 52 ft. and 60 ft. respectively, in which it is proposed to have plumb lifts for the transit of passengers, parcels, &c., to and from the subway, through which an omnibus running on steel rails is propelled, both being worked by steam power. In driving the subway, which will be about 22 ft. below the bed of the river, a wrought-iron shield will be employed overlapping the tunnel, provided with doors in the front, through which workmen can drive the heading, but which can be immediately closed on any appearance of water, and so render all water-tight; this shield will be propelled by powerful screws, and as it progresses, the tunnel segments will be inserted. The whole of the work is under the superintendence of Mr. Peter W. Barlow, jun., C.E., the engineer. The castings for these shafts and the tunnel are all made in segmental rings firmly bolted together. The Tower Subway was commenced on the 16th of last February.

NEW MEANS OF TRANSPORT.

A new method of transport has lately been adopted in Leicestershire for conveying stone from Messrs. Ellis and Everard's granite quarry to the railway, a distance of three miles. The plan has been worked out by Mr. Hodgson, C.E., and consists in the employment of an endless wire rope, supported on pulleys, which are carried at a considerable height from the ground on stout posts, the entire arrangement having much the appearance of an ordinary telegraph line. A portable steam-engine drives the rope at about five miles an hour, and it carries with it a continual stream of boxes, each holding 1 cwt. of stone. The rope is endless, so that the full boxes travel at one side of the supports and the empties return at the other, and the pendants by which the boxes are hung are specially formed to allow of their passing the points of support, which they do with perfect ease. This line crosses the country boldly as an ordinary telegraph would, and from its cheapness, the rapidity with which it can be constructed,

and the ease with which it can be moved, it seems probable the method will be found of considerable use in the development of the resources of new countries as a kind of precursor to the railway system.—*Mechanics' Magazine.*

BOURNE'S NEW AUXILIARY PROPELLER.

IN the *Engineer*, the *Mechanics' Magazine*, and the *Shipping Gazette*, all of April 30, a description is given of the trial of Bourne's Auxiliary Propeller for assisting ships in calms, to be fitted to certain sailing-ships. For many years it has been accounted a desideratum that sailing-ships should be fitted with some propelling instrument of moderate size, which in calms could be let down into the water to carry the vessel forward at the rate of two or three knots an hour. But though numerous attempts have been made to supply such a propeller they have all been heretofore unsuccessful, mostly from the too limited area of water upon which the propeller acted, but sometimes, too, from the necessity of giving such special configuration to the hull below the water as would impair the efficiency of the vessel at other times, and sometimes from the cumbrous nature of the propeller which has been provided. These objections are said to be obviated by the species of propeller which has now been tried, and which consists of a sculling-oar of iron, let down deep into the water on each side of the ship. These oars are moved, and also feathered, by the steam-engine that gives motion to the steam-winches; and consequently the whole of the machinery is on the deck, and the oars are let down into the water to propel the vessel when calms occur, and at other times are lifted out of the water, so as in no way to interfere with the sailing properties of the ship. The propeller has been applied in Messrs. Currie's Castle line of sailing-ships, plying between London and Calcutta; and the application is considered to assume a new importance on the opening of the Suez Canal, as by its means vessels will not only be able to pass through the belt of calms which occur about the middle of the Red Sea, but also to proceed through the canal by their own steam, whereby the cost of towage will be saved.

GRIFFITHS'S IMPROVEMENTS IN THE SCREW PROPELLER.

THIS invention is a new feathering and changing pitch Screw Propeller. The great objection to the screw hitherto has been that when not in use, and the vessel is under sail, it is a serious impediment to progress. Mr. Griffiths' new screw, however, when out of use is entirely under the control of the engineer. It can be thrown out of gear, brought to the feather so that no angle of opposition is offered to the water, and again, when wanted, it can be brought to any pitch or angle that may be desired. The interior works of the ball of the screw are electro-plated, so as to resist the action of the salt water.—*Liverpool Albion.*

THE MOODY LIGHTSHIP.

THIS Lightship, novel in its construction, is the invention of Captain Moody, of York, who seems to have derived the idea of the form of his vessel from the star fish. The four rays or bows which proceed from the body of the ship present a floating area of immense size, and give the Moody lightship advantages it is impossible to gain from an ordinary one.

There is a circular central hold, from which proceed at right angles four equal rays. The extreme ends of these rays are not fine, like the bows of an ordinary ship, but round. The rays are covered by sloping sides, extending to the centre of the vessel, which finishes off by an outward curved bulwark, 4 ft. in height, so as to throw off the spray from the waves as they glide over the sides or run up the bows. The bottom of the lightship is flat, or nearly so, until near the edge, when it is gradually sloped to lessen the resistance when moving through the water. The slip is built in watertight compartments or bulkheads, eight being diagonal, and running from the centre of the edge of each bow and the centre of each curve to join the ninth or circular bulkhead, which goes round the centre of the ship, connecting all the others. Over this central bulkhead is the upper deck. The light can be carried on a tower or mast, or upon an open column—light but strong—made of angle iron. This column rises from the centre of the ship, the weight being placed over the centre of gravity.

There is ample room in the rays and in the centre of the ship for berths, and for all other purposes. The lightship would be at all times comparatively dry, as her form would deflect the waves, so that instead of shipping heavy seas in rough weather, like an ordinary ship, the waves would be deflected and glide under and over her rays. Large scupper holes are placed round her bulwarks to carry off all waste water. It is proposed to fit her up with sails or small hydraulic engines, so that she could be readily moved from place to place, or be under control and perfectly manageable should she from any cause break adrift, which is not very likely to happen. She will be steered by means of eight sluices, two at the end of each ray or bow, one on either side, but if propelled by sails, then a steering apparatus at the end of one of the rays. Her hawse pipes will be placed in the inner part of each curve, and in such a form that the cable can be always paid out in a line with the angle of the sides of the hull. The inventor proposes to moor her by means of three anchors in a triangular position. The advantages which this mode of mooring gives to the Moody lightship is very great indeed.

The easiness with which the Moody lightship would ride has a still greater advantage, and that is it reduces the liability of her breaking adrift. An ordinary ship in a heavy sea is very liable to snap her cable, not so much from the constant strain

as from the jerking strain every time she rises after a plunge into the sea, but there would be no strain of this sort on the cables of the Moody lightship. In her case, the cables running from the central body of the ship, the four rays or bows are free to follow the motion of the waves. We understand the inventor has tested this by a small boat, 12 ft. from ray to ray, at Southend. This boat has no deck covering, yet, although she outrode the winter, she never took the slightest harm nor shipped a pint of water.—*Abridged from the Mechanics' Magazine.*

THE GREAT WOLF ROCK.

THE dangerous pile of rocks lying off the Cornish coast known by the above name, and which was well described by the Prince of Wales on a recent occasion as having long been a terror to our sailors, is now about to be converted from a source of peril into a beacon of warning. The rocks in question are situate about eight miles S.S.W. of the Land's End, and are in extent 56 yards by 38. They are nearly covered at low water, and to add to their dangerous character the water immediately beside them ranges from 30 to 40 fathoms. Placed at the very commencement of the Channel navigation, and their existence almost completely concealed, they have caused the loss of many strong ships and of many hundreds of gallant sailors. For nearly eight years the Trinity Board have been engaged in the erection of a lighthouse upon this dangerous point, but from the peculiar nature of the foundation the work has been arduous and progress necessarily slow. The time available for working on each tide has been reckoned by minutes, and in the whole eight years the greatest number of hours during which workmen could land has been 313 in one year, but in some years that number has been as low as 83. The difficulty of the undertaking may be inferred from the tediousness of its progress, but patient industry, fostered by a sense of the importance of the object in view, has been rewarded by the completion of what will hereafter be recognized as an inestimable boon to all navigators of the British Channel. In July the last stone of the lighthouse which now surmounts the Wolf Rock was laid by Sir F. Arrow, the Deputy-Master of the Trinity House, who followed up his formal task by a brief expression of thankfulness for the completion of a great work, under unfavourable circumstances, without loss of life or serious accident. The lighthouse tower is built of solid granite, and stands 110 ft. above the high-water level. The lantern and lens have yet to be fitted, but it is hoped that these works will speedily be completed, so that the Wolf Rock may no longer be dreaded by the homeward-bound sailor as a hidden peril, but be looked for as a guiding beacon to his welcome home. —*Times.*

CONDENSER FOR STEAM-ENGINES.

A NEW claimant has appeared to the invention of a species of condenser for steam-engines lately brought before the Institution of Engineers in Scotland, by Mr. Morton, in which the air-pump is discarded, and the condensing water is forced out of the engine by the energy of the escaping steam, as in Giffard's injector for feeding boilers. High-pressure steam will escape into the atmosphere and low-pressure steam will escape into a vacuum with about the speed of a cannon-ball. But, as the steam is all the while water, it is easy, by cooling it, to translate it into a very small jet of water moving with a very great velocity, which jet, if made to pass through other water, will carry some of that water with it, and produce a somewhat larger jet of less velocity than at first, but yet of a velocity so great that, if it be directed against a small hole in a boiler, it will overpower the issuing steam and enter the boiler; and in the instrument called Giffard's injector this is the way in which the supply of water to the boiler is kept up. The same expedient has been applied in many cases in substitution of pumps. But it is wasteful. In the case of condensing engines, however, where a large quantity of steam has to be condensed, whether a pump is used or not, it was an obvious expedient to employ this steam in an injector; and this is what Mr. Morton has done, but without any prospect of sensible superiority in the performance of the engine. By a subsequent communication to the Institution it appears that the merit of this innovation is claimed by Mr. Barclay, of Kilmarnock, who patented it several years ago.—*Illustrated London News.*

HEATED AIR-ENGINES.

MR. ERICSSON, a Swede, resident in New York, has long been known for his endeavours to improve the steam-engine, and to construct an engine in which Heated Air should be the moving power. Within certain limits he has been successful, and many air-engines from two to four horse power are now at work in the States. Since then, Mr. Ericsson has turned his attention to the grand question of utilising the sun's rays; and he states that he has devised apparatus by which the heat may be concentrated and used for steam or air-engines. In other words, the solar radiation accumulated on a space 10 feet square and perpendicular to the sun's rays will develop somewhat more than one horse power. Hence the sunshine that falls on the roofs of Philadelphia would keep going 5,000 steam-engines of twenty-horse power each; and with this as a datum any one may calculate the amount of heat power which any given area of the earth's surface would represent while lit by the sun. And the calculation might be applied even to the sun, for, according to Mr. Ericsson, 10 square feet of the sun's surface emit heat enough to run an engine of 45·984 horse power. After this, it is clear that all those gloomy forebodings about the exhaustion of our coal may be entirely dismissed.—*Athenæum.*

CENTRIFUGAL MACHINE.

The Centrifugal Machine has been applied with great success in France to the extraction of the juice of grapes and apples for wine and cider making. It is found to get out considerably more juice, and to be much more rapid in its action. It did with grapes, for example, in two hours more work than the press did in seventeen hours, with this advantage, that all the juice was of the same quality, while, with the press, it is found that it is only the first runnings which will make wine of the best quality, the long contact of the rest with the skins and stalks rendering it fit only for wines of inferior quality. In the case of cider, the use of the machines seems equally advantageous, much less juice being left in the marc, and the extraction being effected with great rapidity. The amount of force required to give a machine of the necessary size a thousand turns a minute, does not exceed that of a three-horse engine.

A WEEK'S WORK IN BIRMINGHAM.

A Week's Work in Birmingham in its aggregate results is something wonderful. It comprises the fabrication of fourteen millions of pens, six thousand bedsteads, seven thousand guns, three hundred millions of cut nails, one hundred millions of buttons, one thousand saddles, five millions of copper or bronze coins, twenty thousand pairs of spectacles, six tons of papier-maché ware, 30,000*l.* worth of jewellery, four thousand miles of iron and steel wire, ten tons of pins, five tons of hairpins, hooks and eyes, and eyelets, one hundred and thirty thousand gross of wood screws, five hundred tons of nuts, screw-bolts, spikes, and rivets, fifty tons of wrought-iron hinges, three hundred and fifty miles' length of wax for vestas, forty tons of refined metal, forty tons of German silver, one thousand dozens of fenders, three thousand five hundred bellows, a thousand roasting jacks, one hundred and fifty sewing machines, eight hundred tons of brass and copper wares, besides an almost endless multitude of miscellaneous articles, of which no statistics can be given, but which, like those enumerated, find employment for hundreds and thousands of busy hands, and are destined to supply the manifold wants of humanity from China to Peru.—*Engineer.*

MORGAN'S PATENT ANCHOR.

The novelty of this Anchor is that it takes the ground with both flukes instead of with one, as in the ordinary anchor. The arms are made to move swivel-like on the shank, so that the palms are always certain to take hold of the ground in whatever direction the anchor may fall on the bottom, or in whatever direction the strain may be on the cable. The stock and the flukes lying both in the same line, it is impossible for the pea of the anchor to penetrate the ship's side when entering

dock or coming in contact with the pier-heads, as was lately the case with the *Clydesdale* and the *John Bull* at Liverpool. It can be used as well without the stock as with, so that if the stock be broken (an occurrence not infrequent) the biting or holding qualities would not be impaired, and both flukes being down, the anchor in shallow water could not damage the ship's bottom in the case of overriding the anchor or grounding. All the parts are made in separate pieces, can be conveniently stowed away, and readily put together when required.

Another important advantage in this anchor is that the several parts are put together without a "weld." The shank is in one piece, having an oval cotter hole punched through it at one end, to which are fastened the two straps, between which "swivels" the "gab strap," and between which again swivel the arms and flukes at right angles, each piece being made without "welds," the whole being riveted or attached by the cotters and bolts.

The extraordinary strength of this anchor has been proved at the Mersey Docks and Harbour Board's Testing Works, Birkenhead, where it withstood the strain of 345 per cent. above Admiralty proof without breaking.—*Abridged from the Mechanics' Magazine.*

NEW BRIDGE AT NIAGARA.

THE New Suspension Bridge which spans the Niagara River a short distance below the cataract has been completed so far that it is passable by foot passengers. The structure, though not so massive and capacious as that built a mile and a half below, is at once an object of marked interest. The width and depth of the chasm at this point rendered the construction of this work quite difficult, and makes it an object of attraction as a scientific achievement in the art of engineering. The dimensions of the bridge, as recorded in the *Buffalo Express*, are:—The span from rock to rock is 1,190 ft.; the span between the centres of the towers is 1,268 ft. The length of the suspended platform is 1,240 ft. Height above the surface of the river, 190 ft. The length of the central portion resting on cables is 635 ft. The length of the platform supported by stays and cables is 605 ft. The deflection of cables at the centre—in summer, 91 ft., and in winter, 88 ft., making the rise and fall of the bridge from changes of temperature, 3 ft. The length of the cables between the points of suspension in medium temperature is 1,286 ft. The length of the cables between anchorages is 1,828 ft. Length of cables and anchors, 1,888 ft. Height of towers above rock on Canada side, 105 ft., and on American side, 100 ft. Base of towers, 28 ft. square, and top, 4 ft. square. The surface of the rock on the American side is 5 ft. above that on the Canada side. The height of the roadway above the rock on both sides is 7½ ft. The depth of the anchor pits below the surface of the ground is 18 ft., and the length of the anchor chains under the ground is

30 ft. The anchors are set in solid rock on the Canada side, and in masonry on the American side. The width of the roadway between the parapets is 10 ft., depth of side truss, 6½ ft., and height of parapet above floor, 4½ ft. The bridge is supported by two cables, composed of two wire ropes each, which contain respectively 133 No. 9 wires. The weight of these wire ropes per lineal foot is 9 lb., and the diameter of the cable is 7 in. The total weight of the suspended portion of the cable is 82 tons net. There are 48 stays weighing 15 tons net. There are 52 guys connected with the bridge. The aggregate breaking strain of the cable is 1,680 tons net, and that of the stays 1,320 tons net, making the total supporting strength of the cables and stays 3,000 tons. The number of suspenders used is 480, with an aggregate strength of 4,800 tons. The weight of the suspended roadway, including weight of cables and stays, is 250 tons. The ordinary working load is 50 tons, and the maximum load is 100 tons; permanent and transitory load, 350 tons. The towers, when completed, will be covered with wood and corrugated iron, and in point of architectural beauty will be highly ornate, imparting to each terminus of the bridge an air of elegance and substantialness, and rendering the whole an attraction among the beauties and wonders of that interesting locality. On the opening of another season, when the roadway will be completed, it will be available for carriages.

MOVING A HOUSE.

THE process of removing bodily the boatman's house on Caversham Bridge has been successfully accomplished, under the superintendence of Mr. Neat, who is managing the works on behalf of Messrs. Head & Co., the contractors; and to those who merely saw the conclusion of the process it did not appear such a formidable undertaking as might have been imagined. An inspection of the necessary preliminary operations, however, dispelled this idea. The house, which was nearly square, with four rooms on the ground floor, and two stories above, was first of all underpinned; but an additional difficulty had to be overcome from the circumstance that the bridge itself had been made use of as the foundation for the front of the house, and it was therefore necessary to support the upper rooms with a number of upright timbers. A strong piece of timber, extending from front to back, and side to side, was then adjusted under each wall, the framework, when completed, forming a square divided into four compartments. The timbers from front to back were protected at bottom by a partial coating of iron; under these were laid similar timbers, protected likewise with strips of iron, but only on the upper surface, and between the two were placed, at intervals of about 6 in., some small iron rollers, 1 in. or so in diameter. The building itself was fastened together beyond the possibility of slipping by strong bars of

iron, and the bottom framework was securely fixed by diagonal timbers. Everything being ready, some hydraulic engines were tried, but were not quite in working order, and recourse was then had to three "screwjacks" placed against the wooden framework opposite to each of the sliding timbers, with the buttress of the bridge as a fulcrum. Each "jack" was worked by two men, and almost imperceptibly the building commenced its retreat without the slightest sign of assistance. The rate of movement was about 6 in. in four or five minutes, but as the "jacks" were worked out they had to be removed, and the intervening space filled with blocks of wood, when the screw was again put on, and this was repeated until the building reached the destined spot. The whole operation of moving, from its commencement, occupied about two hours and a half, the distance traversed being 8 ft.—*Builder.*

HYDRAULIC CEMENTS.

These cements, M. E. Fremy says, are produced, as Vicat established, by the calcination of argillaceous limestones. It is generally admitted that the result from the action of lime on clay is three salts—silicate of lime, silicate of alumina and lime, and aluminate of lime, which become hydrated on addition of water, and so form cements. M. Fremy's researches have been made with a view to putting these theories of hydraulicity to the test. In his first memoir, he demonstrates that the theory of hydraulicity founded on hydration does not apply to all the bodies formed during the action of lime on clay. By producing silicates of lime and silicates of alumina and lime under the most different conditions, he proved that these salts never hydrate nor solidify in contact with water unless they contain some free lime. Following up the five experiments of MM. Rivot and Chatonay, he has demonstrated that of all the bodies which result from the calcination of an argillaceous limestone, aluminate of lime is the only one which has the power of solidifying and forming a hydrate under the influence of water. In the memoir now before the Academy he expresses the following opinion:—"The 'setting' of an hydraulic cement is always due to a pouzzolanic phenomenon: consequently an hydraulic cement should always be formed of two different parts, the pouzzola and the lime bases."—*Scientific Opinion.*

The *Engineer* observes:—The cause of the setting of Hydraulic Cements has as yet not been altogether satisfactorily explained. Whilst Fuchs and Pettenkofer hold that in presence of water, clay and lime form a hydrated silicate, and Pettenkofer ascribes the dead-burning of cement to the production of a silicate in the dry way, Winkler and others believe that during the burning of a cement an actual combination takes place, and that the bodies in question set with water, as burnt gypsum does. Winkler believed himself able to assign formulæ to these compounds, but Feichtinger's researches have

rendered this improbable. Two contributions to the literature of this subject have recently been published on the Continent by Schulatschenko and by Fremy, and below is given a *précis* of the result of their investigations. The impossibility of isolating the silicates in a cement for investigation led Schulatschenko to choose the synthetical method for his inquiry. He repeated the experiment of Fuchs, of mixing 100 parts of pure silicic acid, obtained from water glass, with 50 parts of lime under water, and found that the mass soon set. Such another mixture was raised to a bright red heat, and when subsequently treated with water in like manner, also became hard. That a chemical combination had taken place in the latter case was shown by the comportment of pounded quartz with lime. By heating these bodies together a silicate was formed, for from the ignited mass acids separated gelatinous silica. In the second experiment, therefore, the hardening of the cement must be due to the formation of a hydrate. In a third case a similar mixture was heated till it fused, and the powdered product, when placed in water, did not set. From these observations Schulatschenko concludes: (1.) That hardening of cement occurs not only when the silicate is produced in the wet way, but likewise when it is formed by the dry method. (2.) That Pettenkofer's view, that a silicate formed by the dry way does not set, is not supported by experiment. And (3.) That the dead-burning of cements is to be referred to physical causes.

TURKISH CEMENT.

The following is a Turkish recipe for a Cement used to fasten diamonds and other precious stones to metallic surfaces, and which is said to be capable of strongly uniting surfaces of polished steel, even when exposed to moisture. It is as follows:—Dissolve five or six bits of gum mastic, each the size of a large pea, in as much spirits of wine as will suffice to render it liquid. In another vessel, dissolve in brandy as much isinglass, previously softened in water, as will make a 2 oz. phial of strong glue, adding two small bits of gum ammoniac, which must be rubbed until dissolved. Then mix the whole with heat. Keep in a phial closely stopped. When it is to be used, set the phial in boiling water.

Accounts are given of the healing properties of a New Oil, which is made from the yolks of eggs, and is said to be much employed by the German colonists of South Russia as a means of curing cuts, bruises, scratches, &c. The eggs are boiled hard, the yolks removed and crushed, and then placed over a fire and stirred carefully till the whole substance is on the point of catching fire, when the oil separates and may be poured

off. Hen-eggs are considered the best, and nearly two tea-spoonfuls of oil may be gained from a single yolk.

BEET-SUGAR FARMING.

MR. DUNCAN, of Mincing Lane, seconded by Suffolk farmers, who engage to grow and supply him with the white Pilesian beet—the kind most approved for its sugar-growing qualities—has, at a cost of 6,000*l.*, erected works and machinery at Lavenham for the extraction of the sugar.

The late period at which, with every exertion, it was found possible to complete the works and machinery has necessarily postponed the commencement of the working to the time when, in ordinary circumstances, it should have come to a conclusion. The roots have thus become more dry and fibrous, and the extraction of the sugar consequently proves more difficult. The yield of sugar is thus less than it should be, while the squeezed pulp, which is returned to the farmer for feeding his cattle, is richer in sugar. The extraordinary drought of the season diminished the weight which the crop would otherwise have yielded. As a matter of profit the result this season is not profitable. But enough has been done to satisfy the parties immediately interested in the experiment that there is nothing in the soil and climate of that part of England to prevent sugar-beet culture and manufacture being carried out with the same success as on the sugar farms of Belgium and the north of France. Mr. Duncan has received 800 tons of sugar-beet from the farmers, the growth of 1868, for which he has paid at the rate of 20*s.* a ton. He has entered into engagement to pay the same price this year, and with a favourable season expects to receive 4,000 tons. His works, when fully employed, are capable of using up 60 tons a day, and at this rate would complete 6,000 tons in 100 days working from the end of September, within which time, before the roots become dry, the largest yield of sugar is most easily obtained.

Besides the experiment at Lavenham, Mr. Duncan last spring distributed seed in various parts of the country with the view of testing by analysis the sugar-yielding qualities of different districts and soils. Forty-two specimens, all from different farms in England, and nine from Scotland, have been analysed by Dr. Voelcker, in comparison with some roots from a Dutch sugar farm, also grown last year. The result shows in the English roots an average percentage of 9·61 of sugar, in the Scotch 9·73, and in the Dutch 9·0. The variation is very great, clearly showing that some soils are much more suitable for sugar growing than others, and in certain cases the result would seem to be much influenced by the manure and treatment of the crop. One remarkable result of this experiment demands special notice. Of all the specimens analysed, that grown on the London sewage at Barking proved the highest in sugar-producing quality. Of

this specimen Dr. Hoelcker states, "Fearing a mistake might have been made I repeated the analysis with closely agreeing results. The root marked 'lodge,' taking all in all, was the best of all the roots you sent me. The larger white root from the same farm contained not quite half the amount of sugar which I found in the red. It was decayed in the centre, and probably overripe." It may well be asked, what are they doing with London sewage? At an enormous cost to the ratepayers of the metropolis it has been carried to certain outfalls. Near one of these its fertilising effects have been for some years exhibited to wondering visitors. The most luxuriant crops of milk-producing grass, splendid fields of wheat, the rosiest and most gigantic strawberries, and now, last trial of all, the greatest sugar-yielding beet. Will none of these tempt the investment on our own fields of a small portion of that English capital which flows with such abundance to fertilise foreign lands?

To return to Sugar-beet. The analyses already given seem to prove that the general average of the specimens grown in this country can compete on equal terms with the roots of France, Holland, and Belgium. In these countries sugar farming is every year extending. In France, 1868, the increase was 10 per cent. The home-grown sugar has no protection against colonial or foreign. Its extending culture is a proof that it is an agricultural success; and if we consider the possible diminution in the production of cane-sugar, which would certainly for a time follow the gradual or early abolition of slavery in Cuba, the introduction of sugar farming into this country may become an object of national importance, both as regards consumer and producer. When the price of sugar is low and that of corn high, as has been the case during the last three years, there is no inducement to either to take much interest in the subject. But if we are entering on a period of higher prices for sugar and lower prices for corn, as seems very probable, the case will assume an altogether different aspect. In the ten years from 1857 to 1866 the consumption of sugar per head in the United Kingdom increased from 28 lb. to 38 lb. Any serious change in the supply would now be at once felt by all classes of the community. The substitution in our agriculture of sugar-beet for mangold or peas, to such an extent as would furnish one-fourth of our present supply of sugar, would affect only one-fourth of the acreage now under these crops. And inasmuch as every constituent in the sugar-beet, except the sugar, is returned to the farm as cattle food, the actual loss could be easily replaced by cake or manure.—*Abridged from the Times.*

The origin of the manufacture of Beet-root Sugar, now so extensively carried on throughout France, Belgium, and the States of the Zollverein, presents a striking instance of good educed from seeming evil. Scarcely, if at all, practised in Europe before the century opened, the manufacture sprang into importance as the result of the remarkable fiscal contest waged between Napoleon

and this country, which began with the celebrated Decree of Berlin in 1806. Resolved to isolate Great Britain entirely from the Continent—to place *ces Anglais* under the penalties of excommunication from the brotherhood of nations—the Emperor sought to prohibit all commercial intercourse, even of the least direct kind, between England or her dependencies and any of the countries then under his control. The retaliatory Orders in Council of January, 1807, were the consequence, and the derangement and destruction of trade were rendered total—much to the profit of the smuggling fraternity, who now came into wonderful activity and importance—by repeated decrees and fiscal regulations effectually closing the Continent against the product of England and her colonies.—*Chamber of Agriculture Journal.*

NEW LIMEKILN AT INGLETON.

In the spring of 1868, Messrs. Clark, Wilson, and Co. began to build an extensive Limekiln on the principle of a German patent. As the works have been completed under the management of Mr. Bagnall, C.E., and just been brought into working order, a description of the Kiln is not without interest. The scene of operation, says the *Leeds Mercury*, is one of unusual activity for this quiet neighbourhood. The kiln, which is built on a flat on the north side of a clear mountain stream, with millions of tons of limestone rock on its back, presents at a distance, and especially from the railway bridge, a unique appearance. The kiln is oval, and measures in circumference 450 ft., being surrounded by a road for the use of carts. At the height of 4 ft. from this road, there is a platform all round the kiln 6½ ft. wide. From the platform there are fourteen arched openings into the chambers, for the purpose of taking in the stone and bringing out the lime. Each chamber, which is 9 ft. in height at the centre of the arch and 18 ft. wide on the floor, is capable of holding 100 tons of limestone, and as the stone is calculated to lose by burning two-fifths of its weight in carbonic acid and moisture, a chamber yields at one draw about 60 tons of lime. As it requires many days to convert the stone into lime, and three days to cool a chamber before it can be discharged, 60 tons of lime is the amount produced per day. From the platform to the feeding chamber it is in perpendicular height 11 ft., but, as the wall slopes, it measures 14 ft. The feeding chamber extends over the whole of the fourteen lime chambers, and is 150 ft. in length and 65 ft. in breadth. This chamber, which measures from the floor to the ridge 14 ft., is covered over with a wooden roof, which cost £200. In this chamber, into which there are forty-one brick openings 6½ ft. high by 5 ft. wide, there are 424 feeding-holes, through which, by the use of a small funnel and scoop, the fires are supplied with fuel. In the centre of this chamber are fourteen valves 2 ft. 1 in. in diameter, connected with the chambers which surround a central chamber in

furnace. The average time occupied in heating half-inch plates by this means was seven minutes—12 or 15 minutes representing the time required when the ordinary method is employed. The rapidity with which the plates are heated is not the only advantage afforded by the system in which liquid fuel is used. The plates treated in the manner described were remarkably free from scale, owing to the absence of the deteriorating action of the products of combustion as they exist in the case of the ordinary furnace. The 6-inch armour-plate mentioned above had been three times in the furnace in which it was bent, and still preserved a clean, smooth surface. The advantage presented in the case of thinner plates when heated by liquid fuel and bent double is that they do not crack, as is very often the case when coal is the heat-producing agent. It is estimated that the saving effected by this means, by which deterioration is prevented, would amount to something like 10*s*. per ton of metal treated. The value of the system is also increased by the fact that in the process described the heat can be directed either to the whole or to a part of the plate, so that if it is necessary to bend only one end of it the heat can be applied to that particular portion. The rate at which the metal is heated can be accurately regulated either by increasing or diminishing the number of jets by which the liquid fuel is supplied.—*Times.*

PETROLEUM FUEL.

At a meeting of the French Academy of Sciences, M. H. Sainte-Claire Deville has summarised the description of his researches on Petroleum, undertaken at the Emperor's expense. His results show that the heavier and more viscous mineral oils are, the fitter they are for fuel. Their use in brick furnaces, he observes, is a problem already solved, the method consisting in letting out the oil from a reservoir through a stop-cock on a brick floor, placed behind a clay screen pierced with holes for the admission of the air intended for combustion. For this clay screen, M. Sainte-Claire Deville substitutes a thick cast iron one. An apparatus of the kind described was placed on board the imperial yacht *Puebla,* and was found to answer the purpose perfectly, being employed on a boiler producing steam enough for a 60-horse power engine. About May, 1868, M. Sainte-Claire Deville obtained permission to try his furnace on an engine on the Strasbourg Railway, where it was important to reduce as much as possible the bulk of the apparatus, and to suppress brickwork, since the constant shaking of the engine would be apt to get it out of order. Another difficulty was the quantity of oil, enormous in regard to the small surface at disposal, to be consumed in order to produce steam to the amount of 300-horse power. These difficulties were overcome by substituting cast iron for brick, and by artificially increasing the surface of evaporation, without enlarging the dimensions of

the fireplace. Hence the apparatus intended for a locomotive simply consists in a fireplace so arranged as to present the largest possible surface to the action of heat. The sole of the furnace may be of copper, attached to the boiler, and inwardly kept moist with water. The grating is provided with a series of holes, through which the oil flows. This fuel gives no smoke, and does not emit sparks; the consumption of oil, at the rate of 60 kilometres per hour, was at the rate of 4·70 kilogrammes per kilometre.—*Mechanics' Magazine.*

DRYING CORN.

OPERATIONS for Drying Corn by hot air, whereby it is preserved from injury in wet seasons, and in all seasons is got quickly to market, have been carried out upon a considerable scale in America with much advantage. The use of drying-houses for saving both hay and corn in wet seasons is an improvement fraught with important advantages to agriculture, and there is no doubt that the expedient will one day come into general use.

POTTS'S SYSTEM OF VENTILATION.

THE use of a hollow cornice communicating with the exterior of a room to bring in fresh air or take out foul is not an unknown arrangement. We have used it ourselves on several occasions, and at intervals ranging over some years Nevertheless, the system patented by Mr. Potts is his own, and certainly deserves attention. In this the perforated cornice is formed into two passages, the one next the ceiling, and which communicates by valves with the chimney or other flue, is for the vitiated air, and the lower one, open to the external atmosphere for fresh air. The latter is not perforated near the entrance, so as to give the air a direction along the channel. We have seen the cornice in the billiard-room, where it is found very serviceable. The size of the channels, of the perforations, and of the openings of entrance and exit must of course be apportioned to the size and purpose of the apartment. Mr. Potts forms the cornice of various materials: zinc, or sheet brass, usually; sometimes partly of plaster, especially where old cornices are to be converted. Some houses in Kew and some taverns in the City are being provided with these ventilating cornices, and there is little doubt that as the value and simplicity of the system become known, it will be more extensively adopted.—*Mechanics' Magazine.*

COAL GAS ILLUMINATION.

A PAPER has been communicated to the Institution of Civil Engineers, on "Experiments on the Standards of Comparison employed for testing the Illuminating Power of Coal Gas," by Mr. T. N. Kirkham.

It was observed that the standards of comparison at present in use were known to be wanting in that uniformity of result necessary for determining with accuracy the difference in the intensities of two lights. But as the amount of the variation had never been clearly defined, the author had instituted a series of experiments for the purpose of ascertaining the extent of these differences.

From these experiments the author believed it was evident that a more reliable method than that at present in use, for determining the correct illuminating power of the gas supplied to the public, was urgently needed; and he thought the following system would be found to give results approaching as nearly as practicable to a truthful estimate:—Let the illuminating power of the gas be determined by the aid of the present recognised photometer, fitted with a Carcel lamp, burning oil of the same quality, and verified in the same manner, as that adopted by the municipality of Paris as a standard; and let a sufficient number of experiments be made, so as to cover the errors that were known to exist, and the average of these be compared with the illuminating power, as shown by the jet photometer and the Duration test, and then the "mean of comparison" might be taken as the illuminating power of the gas.

ON GAS-BURNERS.

MR. KIRKHAM, of the Imperial Gas Company, has made a series of experiments on the Burners in common use, and has found as great variations in their illuminating power as those stated by the Gas Referees. Too great prominence can hardly be given to the facts arrived at, for they concern all gas consumers, who are naturally anxious to get the full value of what they pay for, and they are of equal interest to the makers of burners, who may learn from the experiments the principles which must guide them in producing good burners. The variations in the different kinds of burners extended, in round numbers, from fifteen candles to five candles for an equal consumption of gas. This lowest power was found in a fishtail burner, such as is in most common use; and the faulty manufacture of these is shown by the circumstance that burners of the same number, which ought, therefore, to give an equal light, varied in illuminating power from eleven candles to six candles for the same consumption of gas. In the end, perhaps, it may be found advisable to give consumers some guarantee for the proper construction of a gas burner, for it is clear that they are at present supplied with articles which rob them of half the value of the gas they pay for.—*Mechanics' Magazine.*

UTILISATION OF SEWAGE.

DR. PAUL has delivered to the British Association the Report of the Committee appointed on the joint recommendation of the

Economic, Mechanical, and Chemical Sections, to collect practical information upon the utilisation of sewage. He described the measures that had been adopted with this object, and gave a brief *résumé* of the results shown by upwards of one hundred returns from various local sewer authorities in the kingdom, and by very copious official reports of the practices adopted in foreign countries, which the committee had obtained through the liberal aid afforded to them by the Home Secretary, Mr. Bruce. He pointed out two chemical questions relating to the subject that require further investigation before any general measures could be proposed for dealing with town refuse in a manner adequate to meet sanitary requirements, and to admit of its value for agriculture being realised without concurrent disadvantages. These were, first, the determination of the composition of liquid town sewage, as it is now commonly known, chiefly as regards the dilution, and the range of variation in this respect in different instances; secondly, the examination of the gaseous discharge from sewers, with the object of ascertaining whether, and to what extent, it may contain gases prejudicial to health.

MANUFACTURE OF EXTRACT OF MEAT.

THE following particulars of the manufacture of Liebig's Extract of Meat at the Company's establishment at Fray Bentos, Uruguay, South America, are from the Buenos Ayres *Standard:* —The new factory is a building that covers about 20,000 square feet, and is roofed in iron and glass. We first enter a large flagged hall, kept dark, cool, and extremely clean, where the meat is weighed and passed through apertures to the meat-cutting machines. We come to the beef-cutting hall, where are four powerful meat-cutters, specially designed by the company's general manager, Mr. Geibert; each machine can cut the meat of 200 bullocks per hour. The meat, being cut, is passed to "digerators" made of wrought iron; each one holds about 12,000 lbs. of beef; there are nine of these digerators, and three more have yet to be put up. Here the meat is digerated by high-pressure steam of 75 lbs. per square inch; from this the liquid which contains the extract and the fat of the meat proceeds in tubes to a range of fat separators, of peculiar construction. Here the fat is separated in the hot state from the extract, as no time can be lost for cooling operations, otherwise decomposition would set in in a very short time. We proceed downstairs to an immense hall, 60 ft. high, where the fat separators are working; below them is a range of five cast-iron clarifiers, 1,000 gallons each, worked by high-pressure steam through Hallet's tube system. Each clarifier is provided with a very ingenious steam tap; in the monstrous clarifiers the albumen and fibrine and phosphate of magnesia are separated. From hence the liquid extract is raised by means of air-pumps, driven by two 30-horse power engines up to two vessels about 20 ft. above the clarifiers; from thence the

liquid runs to the other large evaporators. Now we ascend the staircase reaching the hall, where two immense sets of four vacuum apparatus are at work, evaporating the extract by a very low temperature; here the liquid passes several filtering processes before being evaporated in vacuum. We now ascend some steps and enter the ready-making hall, separated by a wire gauze wall, and all windows, doors, &c., guarded by the same to exclude flies and dust. The ventilation is maintained by patent fans, and the place is extremely clean. Here are placed five ready-making pans, constructed of steel plates with a system of steel discs, revolving in the liquid extract. These five pans, by medium of discs, 100 in each pan, effect in one minute more than two millions square feet evaporating surface. Here concludes the manufacturing process. The extract is now withdrawn in large cans, and deposited for the following day. Ascending a few steps we enter the decrystallising and packing hall, where two large cast-iron tanks are placed, provided with hot water baths under their bottoms; in these tanks the extract is thrown in quantities of 10,000 lbs. at once, and here is decrystallised, and made a homogeneous mass, and of uniform quality. Now samples are taken and analysed by the chemist of the establishment, Dr. Seekamp, under whose charge the chemical and technical operations are performed. It may be mentioned that the company's butcher kills at the rate of eighty oxen per hour; separating by a small double-edged knife the vertebræ, the animal drops down instantaneously on a waggon, and is conducted to a place where 150 men are occupied dressing the meat for the factory, cutting each ox into six pieces; 400 are being worked per day.

PRESERVATION OF MEAT.

M. GORGES has invented a process, reported to the Société d'Encouragement of Paris, which is as follows:—He first immerses the meat in a mixture consisting of 85 per cent. of water, and the remainder glycerine, hydrochloric acid, and bisulphite of soda. When withdrawn from this bath, the pieces (which may be from four to a hundred pounds in weight) are dusted over with powdered bisulphite of soda, and closely packed in tinned-iron cases, and soldered down. The meat, it is said, will keep fresh and juicy for any length of time, and, when the cases are opened, the joints will look as though they had been cut only a quarter of an hour before. The flavour of sulphurous acid they will certainly possess can, we are told, be easily got rid of by washing them with vinegar and water, and leaving them in the air, to which they may be safely exposed for eight and forty hours. However inventors may differ as to the means they employ, they all agree in telling us that meat prepared by their processes in South America can be sold at a profit in London or Paris for 2½*d.* or 3*d.* per lb. It is curious that no one seems to have the courage to speculate with a cargo.—*Mechanics' Magazine.*

A limited Company has been formed in Australia, called the Melbourne Meat Preserving Company. After considerable delay necessary for importing machinery and plant, and erecting buildings—the factory—it commenced operations. Thirty-five thousand sheep have been slaughtered, and 54,000 canisters of meat and 190 tons of tallow have been shipped to the company's agents in London, while 50,000 more canisters were in process of being filled. Confident expectations seem to prevail that the meat, as reported on by the Duke of Edinburgh, will come into extensive use, especially for ships. Several additional companies were actively engaged in making consignments of preparations by various other processes, and boiling down for tallow was again being largely resorted to. It is estimated that there are 45,000,000 sheep on the continent of Australia. In Melbourne fat sheep were selling at 4*s.* each for ewes, and 5*s.* to 7*s.* each for wethers. In the country districts of Victoria, good sound two-year-old ewes were sold with difficulty at 3*s.* 6*d.*, and fat wethers at 5*s.*—*Times.*

FOREIGN HAMS.

THROUGH the kindness of a Correspondent well known in botanical circles, we have had an opportunity of examining a remarkable specimen of prepared meat, stated to be a "portion of a Westphalian ham," sold in London for 16*s.* as an article of food. The slice is about one inch square and one-third of an inch in thickness, weighing considerably less than half an ounce. It could readily be swallowed at a single mouthful. From its odour and appearance, we should say that the only "smoking" it has undergone is such as would be imparted by a few hours' immersion in a solution of creosote. At all events, the muscular fibres have a glistening, fresh, carneous look, their transparency strongly contrasting with thinly-scattered fat masses, with tendinous and aponeurotic fibres, and more especially with a number of small cysts, most of which lay beneath the cut surface. These cysts, of which we have removed no less than twenty without breaking up the slice, contain each of them a larva of the well-known pork tapeworm, better understood as the *Cysticercus cellulosæ.* On microscopic inspection the latter were found to be alive, their characteristic hooklets, suckers, and corpuscles being all well formed. As we have probably not removed more than half the number of measle vesicles present in this precious morsel, it would be safe to say that the "mouthful," if swallowed in the condition in which we received it, would give rise to the formation of more than thirty tapeworms in the intestinal canal of the person who ate it. That such meat should ever be sold in any shape is simply disgusting. Fortunately, our English hams are free from these parasites. The small white chalky deposits which one often sees in them, are formed during the salting and smoking of the flesh. Their irregular form, with a size varying from that of a mere speck, to one, two, or more lines in length,

at once reveals their true character. Nevertheless, these soft secretions are often mistaken either for trichina capsules, or, more commonly, for degenerated and calcified measles.—*British Medical Journal.*

HOLMES' PATENT STONE-DRESSING MACHINE.

THIS machine, which is an American invention, consists of a simple arrangement by which a block of stone can be made to travel beneath a transverse bar, carrying either a series of chisels or a single knife. To this bar a kind of oscillatory motion is imparted by a crank axle, so that the action of a workman's hand and mallet is very exactly imitated, but with a speed and force that no workman can attain. Certain varieties of granite that have hitherto had no market value on account of their extreme hardness, the cost of dressing having exceeded the worth of the material, can be worked by the machine with the utmost facility. The ordinary process is first to subject the rough stone to the action of a row of chisels, separated by interspaces, so that the surface is grooved, and then to replace the chisels by a continuous blade, that reduces the grooved surface to one that is uniformly level. Two blocks of Portland stone were exhibited, measuring about 6 ft. in length by 21 in. in width and 14 in. in depth. One of these blocks had been dressed by hand by a skilful workman, who completed his task in 15 hours and a half. The other was dressed by the machine in two hours only, and the machine-dressing was certainly superior in finish to that done by hand, with the single exception that an accidental notch in the blade displayed itself as a continuous ridge on one of the surfaces. The inventor considers that one-horse power should be used for each foot in width of the surface acted upon; and, of the machines exhibited as above, one was worked by steam and one by hand. The latter could be turned easily by a single

LEWTHWAITE'S PATENT MAGNETIC STEEL SHARPENER.

A VERY excellent and simple instrument for giving an immediate and highly-finished edge to knives, razors, scissors, surgical and all other cutting instruments, is the invention of Mr. J. Lewthwaite, of Museum Street, Bloomsbury, who is well known as the inventor and patentee of the celebrated railway ticket-printing machine. The sharpener owes its very peculiar properties to the introduction of the magnetic steel sand of Taraniki into its composition.—*Mechanics' Magazine.*

WATCHMAKING BY MACHINERY.

THE result of the introduction of machinery into the watchmaking trade is already to be seen in the comparatively low price at which that necessary article is to be obtained, but hitherto the great drawback has been that machinery was unable

to compete with hand-work in the extremely delicate manipulation of the watch. The difficulty has, however, been entirely obviated by an American invention, which has been purchased and improved upon by Mr. Edwin Streeter, of Conduit Street, which, with the exception of the hair-spring, makes every portion of the watch with a nicety scarcely to be surpassed. One of the chief advantages is that each part being made by a separate machine, can in the event of damage be supplied through the post to any part of the world.

THE WHITBY JET TRADE.

THE local drawing class connected with the Whitby Mechanics' Institute is doing much for the jet trade, and it has risen from six to between fifty and sixty lads who attend during the winter. The master is indefatigable, but he can only get them to a certain point, and a local correspondent wishes to know how they could obtain some models for the drawing class, or whether the Kensington Museum would aid them, there being no School of Art in the place. Designs in fruit, foliage, and flowers have been extensively used, but the material is rather fragile for some of the designs, and a desire for variety has led to other patterns being chosen, especially those allowing of greater solidity, and the best workmen are now imitating Roman cameos and antique gems in high relief. The material is becoming dearer than it was. There is in the town a very general wish to assist the workmen, and raise the manufacture in artistic excellence; but it is difficult to know in what way this can be best promoted. At present it would probably be impracticable to establish in the town a permanent School of Art; but it is worthy of consideration whether something might not be done to form a collection of models and such objects as are used in art-education, and to obtain occasionally the assistance of the living instructor; not merely for the sake of the jet manufacture only, but also for the promotion of art in some other trades of importance in the town, and to improve the public taste. We shall be glad to receive any suggestions to these ends.—*Builder.*

NEW INK.

A GERMAN journal states that an excellent Black Ink may be made from elder-berries, by bruising them and placing them in a jar in a warm place for three days, filtering the juice, and adding to every twelve quarts of it 1 oz. of sulphate of iron and 1 oz. of pyroligneous acid.

NEW POWER-LOOM.

THIS Power-loom, for simplicity of construction, gives promise of a great change in the arrangement of the working parts of such machines. The loom is the patented invention of Mr.

Moore, of Manchester, and Mr. Gadd. The loom in question has no crank shaft or tappet shaft, or their consequent wheels, all the motions being conveyed through one driving shaft, placed in the usual position of an ordinary crank shaft. The shaft revolves at one-half the ordinary speed—that is to say, the loom makes two picks during one revolution of the shaft, the cam causing the sley to perform two complete strokes during one revolution of the said cam. The cam is formed with a flange, the outer surface of which operates upon an anti-friction bowl, revolving on a pin fitted in bearings formed in the sley-sword, while the inner surface of the flange operates upon a second anti-friction bowl revolving upon a stud fixed to a drag link, the link oscillating to some extent around the centre of motion of the bowl as the cam revolves, in order that the bowl may accommodate itself to the movements of the cam. As the cam revolves, the bowls are acted upon alternately, and the sley is caused to vibrate, moving forwards to beat up the weft when the one bowl is acted upon, and backwards to admit of the passage of the shuttle when the other bowl is acted upon, the form of cam being such as will impart a movement to the sley similar to the movement which would be imparted thereto by a crank and connecting rod acting in the ordinary manner. The picking shaft is actuated by a tappet fixed upon the shaft, the tappet acting on the arm of the picking shaft, a corresponding arrangement being employed at the other end of the loom. The healds are actuated by levers, a vibrating motion being imparted to them by means of eccentrics mounted on the shaft. Attached to the loom is a new arrangement for putting the requisite drag on the yarn beam without the use of levers and weights, with a very simple letting-back motion—worthy of notice, as it is a cheap substitute for the heavy and cumbrous levers and weights ordinarily used. As the patentees state that the cost of one of their looms, including royalty, is at least 10 per cent. less than the cost of looms similar in reed space and strength hitherto and now being made, it becomes a matter of interest to machinists and manufacturers to give care and attention to this new loom, and to decide whether a radical change in loom construction, such as that here shown, is henceforth to obtain.—*Mechanics' Magazine.*

DYEING AND PRINTING.

At the present time, sumach is much used in dyeing and printing, in order to cause other dyes to take better on the fabrics or fibres of materials to be dyed or printed. According to an invention lately patented by Mr. J. L. Norton, of La Belle Sauvage Yard, Ludgate Hill (whose name is well known in connection with the Abyssinian Tube Well), an extract of the bark of the hemlock tree is substituted for the sumach, the desired result being thus more effectually and economically attained.

THE LARGEST ROPE IN THE WORLD.

It is, perhaps, hazardous to say of anything that this is the largest specimen of its kind in the world. But we (*Birmingham Daily Post*) may fairly say this of an enormous rope just made by our townsmen, Messrs. John and Edwin Wright, Universe Works, Garrison Street, so widely known by their share in the production of all the principal ocean telegraph cables, including the new French Atlantic Cable, now in course of construction. We have more than once had occasion to mention Messrs. Wright's extraordinary performances in rope making; but this latest one is so extraordinary as to merit special commemoration. The rope, which is intended for shipment abroad, is 11,000 yards long, measures 5¼ in. in circumference, and weighs over 60 tons. These figures are enough to take one's breath away; but when we come to see how the monster is built up, there is cause for still greater surprise. The rope (made of Messrs. Webster and Horsfall's patent charcoal wire, laid round a hemp centre) consists of six strands, with ten wires in each strand. Each wire measures 12,160 yards, so that the entire length of the wire reaches the enormous total of 726,000 yards, or 412½ miles. To this has to be added the length of yarn used for the centre—namely, twenty-seven threads, made from Petersburg hemp, each thread measuring 15,000 yards, and giving a total length of 405,000 yards, or about 230 miles. Adding together the wire and yarn, we have a grand total of 1,131,000 yards, or 635 miles of material—all going to make up a monster wire and hemp rope a little under 6 miles long. Such a rope certainly has never yet been made; and we doubt whether, excepting in Birmingham, such a one could be made. As it lies in vast coils in Messrs. Wright's machine-room, it looks like a miniature Atlantic cable, multiplied by five times the cable thickness. Of course such a rope will bear an enormous strain, and its capacity in this respect is increased by the perfection of the machinery employed in the manufacture, giving the strands an exactly uniform "lay," and imparting the regularity and the precise angle of "twist," which experience proves to possess the greatest resisting and holding strength.

CURRYING AND DRESSING LEATHER.

Hitherto, in Currying and Dressing Leather, it has been usual to employ neatsfoot oil or cod or fish oil, together with tallow. According to an invention lately patented by Messrs. Vanner and Prest, of Great St. Helens, London, the residuum oil obtained when distilling petroleum is employed for this purpose. When the residuum oil is of a specific gravity of about ·880, which is about the specific gravity of the oil as now usually manufactured, it is used with tallow in the proportion of 14 lb. of oil to 16 lb. of tallow. By thus using the residuum oil in place of fish and other oils hitherto employed in currying and dressing leather, it

will be found that the oil so combines with the tallow as to carry it almost wholly into the skin, and so forms a good stuffing, and also that it gives greater elasticity and more permanent weight to the skin than any oil now in use; it also renders the leather more impervious to water and less liable to decay or gum. The inventors employ the residuum oil obtained when distilling petroleum by the aid of a partial vacuum in a still heated by an internal steam coil. A mixture, consisting of fourteen parts of the residuum oil to sixteen parts of tallow, with two to three parts of cod oil added, to make the mixture more fluid, that it may work easier, will be found very suitable for dressing leather, or in cold weather less tallow might be employed. When using a stuffing composed of vacuum oil and tallow and cod oil, as above described, care should be taken in regard to the amount of stuffing used, for if too much is applied it will strike through, and make the grain of the leather dark. A currier will readily judge the amount necessary to apply if he bears in mind that the residuum oil so combines with the tallow as to carry it almost wholly into the skin.—*Mechanics' Magazine.*

NEW USES FOR OLD SHOES.

Old Shoes are not altogether wasted, but they have been put to a new use by M. Guyot. He cuts them up into thin shreds, and treats these with chloride of sulphur. Under this treatment, the shreds at first swell up and then become friable and brittle. When this stage is arrived at, they are washed, dried, and ground to a fine powder, which we are told is of a grey-rose colour. This is mixed with some gummy or glutinous matter, and the mass is pressed into moulds to form combs, buttons, knife-handles, and such like articles. During the treatment with chloride of sulphur, it must be mentioned that the vapour of hydrochloric acid is given off, which, on hygienic grounds, requires to be condensed. Then when the shreds arrive at the brittle state, it is necessary to remove the excess of chloride of sulphur, and we imagine sulphur also. This is done by washing with sulphide of carbon, the recovery of which demands precaution. Taking all things into consideration, we doubt whether M. Guyot can make much profit by his process for converting old shoes into combs; although, by putting on the head what was once on the feet, he may, in one sense, be said to make both ends meet.—*Mechanics' Magazine.*

NITRO-GLYCERINE EXPLOSION.

It appears that about four tons of Nitro-Glycerine formed part of a cargo from Messrs. Nobel and Co., of Hamburg, to Carnarvon, consigned to their agents in Carnarvonshire. The ship was moored in the river Menai, and a portion of the explosive oil having been placed in the Llanddwyn magazine, the rest was brought in lighters and placed on the quay in Carnarvon. After

waiting for some hours without the carts which were to have carried the nitro-glycerine to the mines having arrived, other men —who are stated to have been used to removing the material—with two carts, were engaged. These left about 4 o'clock in the afternoon, with a portion of the nitro-glycerine, . for Glyn-rhonwy quarry, in the vale of Llanberis. The two carts appear to have been of the most ordinary kind, and without springs, or any other means of absorbing the sharp jolts a rough road would inevitably cause. The carters proceeded through the village of Cwm-y-glo, where they had stopped to refresh themselves, and while still within sight of the loungers, the terrific explosion took place, which scattered death and destruction around. The details of scattered atoms of flesh, and fragments of the carts, are sickening, and may well be passed by; but to show the violence of the shock, we may mention that two holes of over 7 ft. in diameter and depth, and about a horse's length apart, clearly indicated the fatal spot. The catastrophe occurred exactly where the diversion of a new road lately made by the Llanberis and Carnarvon Railway joins the old road, about 400 yards beyond the centre of Cwm-y-glo village, five miles and a half from Carnarvon, and 300 yards from Pont Rhyddallt, the bridge that spans the narrow water uniting the upper and lower lakes of Llanberis.

Such, in brief, are the particulars of the explosion; the results were death to nearly a dozen persons, and serious injury to a great number more, besides a large destruction of property. A coroner's inquest was of course held, and a verdict of "accidental death" was returned. From this verdict we entirely dissent, as it is clear that the explosion was the result of sheer carelessness. The tins of nitro-glycerine were packed with straw in wooden cases, and placed for transport, over a rough mountain road, in a common tumbrel. Thus, no precautions whatever were taken by the carriers to counteract the concussive effects of jolting upon this dangerous material. If no decent carts were to be had, or if there was no such thing as sand at hand wherein to bed the cases, they ought never to have been allowed to leave the quay. There is another and well known alternative with which, we should think, those in charge of the deadly material ought to be familiar, and that is to mix the nitro-glycerine with methyllated spirit, which renders it perfectly harmless. Some one or other of these preventive measures certainly ought to have been taken. As, however, we cannot find that any precautions whatever were adopted, we attribute the explosion not to "accident," but to gross and culpable negligence.

But we go still farther, and say that an explosion—even an accidental one—of nitro-glycerine, ought never to occur at all, for the simple reason that it ought never to be used. We know its value to our miners, and should therefore hesitate to cry it down utterly, did we not also know that there is an equally efficient, but infinitely safer, material which ought to supersede

it. We allude to dynamite, which is simply nitro-glycerine incorporated with sand, and by this means rendered harmless under every condition except that of being fired with a percussion fuze. Ordinary fire simply burns it quietly up, concussion will not affect it at all; but ignite it with a percussion fuze, and all its resistless energy is instantly developed. We speak from experience in this matter, having been present at a series of crucial experiments which took place about a year since. This substance is also the invention of Mr. Nobel, and we wonder that he can sell an ounce of nitro-glycerine, when a practically safe substance, giving equal effect, is to be had. But a few shillings a ton in favour of the dangerous commodity may be at the bottom of the matter, and this often makes all the difference in the world with some people, who are willing to accept any risk provided they can pocket a few pence by it. We are aware that there are rules and regulations with respect to the storage and transport of nitro-glycerine. All we can say is, that if they were observed on the present occasion, they are wretchedly inadequate for the purpose, and should be revised at once.—*Abridged from the Mechanics' Magazine.*

NEW EXPLOSIVE.

The recent disastrous explosion in Paris in a manufactory for the preparation of picrate of potassium, coupled with the fact that there are many other such establishments in which the accident may any day recur, gives a peculiar interest to details simply chemical in their nature. The picrate of potassium is the potassium salt of an acid to which the names trinitrophenol, trinitrocarbolic acid, picric acid, carbazotic acid, picranisic acid, chrysolepic acid, &c., have been given. The acid, a frequent product of the action of nitric acid on organic substances, was discovered by Hausmann in 1788; has been the subject of investigation by Liebig, Dumas, and Laurent; and was first accurately described by the last-named chemist, who proved it to be carbolic acid in which three atoms of hydrogen have been replaced by three atoms of the group NO2. This constitution at once explains the explosive character of the acid and of its salts. It will be seen that the oxygen, of which there is a large quantity, is nearly all combined with nitrogen. Now, compounds of oxygen and nitrogen are very easily decomposed, especially in the presence of substances having a powerful attraction for oxygen, such as carbon and nitrogen. Gunpowder, for example, is a mixture of a substance containing oxygen united to nitrogen (saltpetre), and a substance having a strong attraction for oxygen (charcoal); while in gun-cotton, nitro-glycerine, picric acid, and the picrates we have the two united in one compound. Stored up in all these substances is a potential energy which betrays its presence by explosion when the oxygen leaves the nitrogen to unite with the carbon and hydrogen. The picrates differ a good deal as to the rapidity and violence of this decomposition; the picrates of

mercury, silver, and copper on the one hand burning quickly, like loose gunpowder, and on the other, the picrates of calcium, lead, and especially potassium, exploding with a loud detonation when heated on a flat plate, or when sharply struck by a hard body. The first to make practical application of this property of picrate of potassium was Mr. Whitworth, who used the salt to fill shells to be directed against the armour-plating of ships. While picric acid may be prepared by the action of nitric acid on many organic substances, such as indigo, aloes, silk, carbolic acid, or salicin, the most convenient and economical material is the so-called "yellow gum," or resin of the *Xanthorrhea hastilis*, which yields, according to Dr. Stenhouse, about 50 per cent. of the crystallized acid. The substance is chiefly used as a yellow dye for silk and wool, and as a means of distinguishing animal from vegetable fibres, the former being coloured yellow by it, the latter remaining unchanged. It is employed in the laboratory to distinguish salts of potassium from those of sodium; the picrate of potassium being very sparingly soluble in water, while the picrate of sodium dissolves readily.—*Lancet.*

SUBSTITUTE FOR GUNPOWDER.

A PAPER has been read to the Institution of Civil Engineers on Coal-getting Machinery as a Substitute for the use of Gunpowder, by Mr. C. J. Chubb. It was remarked that the improvements now needed in the art and practice of coal-mining might be thus specified, first, to ensure greater safety to the men employed in working, and, secondly, to obtain the coal in better condition, and, by preventing as much as possible the loss arising from waste, to make more fully available all the remaining resources of the coal fields. It was contended that the use of gunpowder and the operation of blasting must be altogether abandoned; and the problem to be solved was, what force could be applied which should be equally effective, and at the same time break the coal in a more perfect manner. The author thought some more simple and practicable means of getting coal by mechanical power could be devised than the costly, but skilfully contrived, coal-cutting machines. His first idea was to apply wedges, acted upon by hydraulic force, but he was induced to abandon that system, owing to objections to the use of wedges, and to adopt instead an apparatus consisting of twelve plungers, set side by side in a steel bar, which plungers, when acted upon by water from a hydraulic pump, would separate the bar in which they were set from another bar, formed in the shape of a cover upon the plungers. The pressing apparatus was 25 in. long, and it was attached to a hydraulic pump by a tube 2 ft. in length, so that it might be inserted into the coal to a depth of about 3 ft. 6 in. The apparatus, with the cover on, was 4¾ in. in diameter. When, by the action of the pump, the plungers had reached their limit of 2¼ in., and further expansion was needed, the plungers

were readily brought back to their first position, by opening an escape cock for the water, when a liner could be inserted between the plunger and the cover; and this process could of course be repeated. In practice, however, it was found that the first expansion to $2\frac{1}{4}$ in. was more than sufficient. It was stated that the collective area of the plungers was 24 square inches, and as the pump could exert a pressure of 12 tons on the square inch, a total pressure of 288 tons could be brought to bear on the coal.

This apparatus has been tried in the South Wales district, where the coal was of the most varied description. It was observed that by the present system of blasting, it occupied, on an average, two men ten hours to break down and fill into trams 4 to 5 tons of coal, of which 20 per cent. was "small," and the remainder much shattered. On the other hand, with this apparatus, two men could readily break down 20 tons in one hour, which could be filled, when loosened, at the rate of 10 tons per man per day, the whole of the coal so obtained consisting of large solid pieces. Again, by the present system, in order to break down 500 tons of coal a day, from a "four-foot" seam, a "face" of 600 yards was required, whether as "pillar and stall," or as "long work"; whereas, with this apparatus, the same quantity could be worked from 300 yards of "face." In this way there would be less space requiring to be ventilated, the working operations could be concentrated, and facilities would be afforded for effecting economy in other respects.

SELF-INFLAMMABLE MIXTURE.

M. Nicklès has published a paper on Greek Fire, in which, of course, Fenian Fire comes in for a long notice; and he also describes a novelty to us, which, it seems, is known in France as the *feu lorrain*. This latter compound is certainly far more dangerous than the solution of phosphorus in bisulphide of carbon, which obtained the name of Fenian fire; but, at the same time, it is more difficult to employ, since the ignition is instantaneous and violent. The ingredients of the composition are a solution of phosphorus in bisulphide of carbon and chloride of sulphur. When strong liquor ammonia is added to this mixture, violent chemical action ensues, and sufficient heat is developed to instantly ignite the inflammable ingredients. It is easy to see how such a mixture could be applied to incendiary purposes. A thin glass bottle containing the ammonia could be placed in a larger vessel containing the inflammable mixture, and then, if this were thrown against any object, with sufficient violence to break the ammonia bottle, an explosion and a fire must necessarily ensue. An experiment may be made by placing some of the mixture in a porcelain dish, and pouring some ammonia upon it; but the experimenter is recommended to fix his ammonia bottle on the end of a long stick, and put a safe distance between himself and his experiment. For the lecture-

room, an illustration may be given by introducing a strip of filtering paper soaked in strong ammonia into the mixture, by which it is ignited, but the action is not so sudden nor so violent. M. Nickles concludes his paper by showing how this mixture and the Fenian fire should be treated to render them harmless. The simplest means is obviously to add to them a solution of oxide of lead in an alkali, by which the phosphorus and sulphur will be converted into harmless and uninflammable compounds.

MACHINE FOR MAKING LUCIFERS.

In a memoir presented to the Société des Ingénieurs civils, by M. Henri Peligot, it is estimated that the daily consumption of Lucifer Matches in France is at the rate of half-a-dozen per head of the population. The proportion for England is as high as eight, and it reaches nine for Belgium. Basing the estimate upon that of six per head per diem, the daily consumption of these useful little articles throughout the whole of Europe will be over two thousand million. The weight of lucifer matches varies considerably. Those most in use in France give about 1,340 to the pound, while the same weight will yield three times as many of the round and square description common in Austria and Sweden. Striking an average, and assuming 1,700 as the datum, the daily quantity of wood consumed in their manufacture would amount to three hundred tons. Poplar and aspen are the trees generally felled for the production of matches. The weight of the former per cube foot is equal to 27 lb., and that of the latter to 40 lb. As timber, however, is purchased in the log, an allowance must be made for waste, and taking the mean of the two descriptions of timber, the cube foot would only weigh, when squared and reduced to actual available dimensions, about 20 lb. Again, an allowance must be made for loss by sawing and other causes that will arise before the wood becomes converted into the marketable article. Summing up these several deductions, it will be found that out of a cubic foot of rough unhewn timber not more than a quantity equal to 18 lb. will be practically utilised. Upon this supposition, the annual consumption of timber for the manufacture of lucifer matches throughout the whole of Europe will amount to 14,800,000 cube feet, or 296,000 loads, reckoning 50 cube feet to a load.

The manufacture of matches is a branch of the industrial arts that has given rise to the formation of several important establishments and firms for that particular purpose. A large one in Austria employs 5,000 workmen, and the MM. Four et C^{ie}, of Marseilles, have work enough for 1,000 more. It is calculated that upwards of 50,000 persons are concerned in the fabrication of these articles in the various countries of Europe, and that the value of their production reaches the figure of £120,000. Before describing the action of the machine, the general opera-

tions attending the manufacture of lucifer matches will not be without interest. The first step consists in cutting up the blocks of wood, which may be accomplished with the saw, the knife, the machine, or the plane. When the knife is the instrument employed, the block is cut at once to the required length. It is then cleft twice in opposite directions by a large knife strongly resembling that used by bakers, and by these means small thick pieces are produced ready to be "dipped" previous to undergoing the final operations. The dipping is simply plunging one end of the wood into a quantity of sulphur in a state of fusion, and the next process is effected by inserting the sulphurised extremity into a pasty chemical preparation, which is spread out upon a marble slab to the thickness of about the tenth part of an inch. The cutter of the plane used to divide these small blocks into single pieces has a peculiar formation. It is composed of a flat quadrangular bar, of cast steel, five inches long, half an inch broad, and a quarter of an inch thick. This bar is slightly turned up at one end, and thinned down by the file. Three cylindrical holes are drilled in it, which become the cutters which divide the block into small round parcels. Some planes have five holes in them, and consequently can subdivide a block into five smaller pieces at one blow. The blocks are in lengths of about 2 ft. 6 in., and the blow of the plane being given along the entire length, they are at once divided into three or five smaller pieces. These are made up into bundles and tied together with strong twine. Subsequently, the cutting of these bundles into their proper lengths for lucifers is accomplished either by a knife similar to that already described, or by a circular saw. The whole operation is conducted with extreme rapidity, a single workman being able to cut up blocks in one day sufficing to furnish 2,000,000 matches. If the plane commonly employed in the Austrian establishments be supposed to be converted into a machine, it will give an excellent idea of that in ordinary use in France. The cutter of the plane is pierced with either three or five holes, and at every forward stroke cuts the block into as many subdivisions as there are holes in the cutter. As may be expected, there have been numerous patents taken out for machines to accomplish rapidly and effectually the operations just described.—*Abridged from the Mechanics' Magazine.*

THE MARTINI-HENRY RIFLE.

CAPTAIN MAJENDIE, R.A., has read, at the United Service Institution, a paper on the subject of the Martini-Henry rifle. Having sketched the history of arms, more particularly in the sixteenth and seventeenth centuries, the author of the paper directed the attention of the audience to the results of General Russell's commission in 1864, which recommended that our soldiers should be armed with breech-loading rifles. The policy of converting muzzle-loaders had been also then approved; the

shooting part of the rifle was to be removed from the loading part, and the rate of delivery was to be increased, so as to be commensurate with the requirements of modern warfare. The intentions of the committee to which he had referred had been fulfilled, inasmuch as the navy, the army, and a portion of the militia had been provided with breech-loading rifles. Speaking of the Snider-Enfield gun, he said that its value had been demonstrated during the Abyssinian campaign. One of these guns had fired as many as 72,000 rounds without requiring any repair worth consideration. Why, then, it might be asked, should the Snider-Enfield be superseded? Replying indirectly by another question, he asked should no further improvement be made or adopted? Having read an extract from the report of the Ordnance Committee for 1862, he continued to state that the highest prize awarded in the competition which ensued had been adjudged to the Henry rifle—the Martini weapon then standing seventh in the list. The inferior position of the latter was, however, attributable to defects of ammunition, copper-fire cartridges having been used in its trial. The Daw cartridge was then recommended. This was like the service cartridge, inasmuch as it consisted of thin coiled brass. Unlike the service cartridge it was secured by soldering the edges instead of cementing them with paper fitted into the base.

The whole subject then divided itself into two parts—the one regarding the common denominator for barrels and the other concerning the method of loading. With respect to the barrel question the superiority of the Henry rifle had been demonstrated by a preponderance of competent authority, as regarded trajectory, accuracy, initial velocity, and penetration. Other qualifications, he urged, were not to be postponed to those he had enumerated. The Henry rifle, however, did not exclude any of these to which he had last referred. Regarding loading, it was admitted that the operation should be performed at the breech. In this case mere rapidity was not the only thing to be considered. The durability of the breech mechanism, its simplicity, its safety, its ease of manipulation, its non-liability to injury by exposure or rough usage, were all-important in directing opinion on the subject. In the competition to prove rapidity the following was the order of merit:—1, Westley-Richards; 2, Martini; 3, Henry; 4, Westley-Richards (equal); 5, Berdan; 6, Money-Walker. The exposure-test, however, had reduced the competition to the Martini and Henry weapons. The parts in the latter were much more numerous than those in the former, which was easier of manipulation and also somewhat cheaper.

He then explained the construction of the rifle, which, he said, consisted of a swinging block hinged on a pin, passing through its near end, the recoil being taken by the shoe. The cartridge was exploded by a direct-acting piston, driven by the impress of a strong spiral spring within the breech block. The block was moved by the action of a lever to the rear of the trigger-guard.

The motion of pushing the lever forward depressed the block, compressed the spring, and ejected the empty cartridge. When the lever was drawn the block was raised and the breech closed. In the Martini-Henry rifle the advantages of both the separate weapons had been combined. The following targets had been obtained at the following distances:—300 yards, ·47 ft.; 500 yards, ·79 ft.; 800 yards, 1·29 ft.; 1,000 yards, 2·19 ft.; 1,200 yards, 2·28 ft. He then answered several of the objections made to the adoption of the new rifle. He denied that the face of the block was convex, as alleged by those who condemned it. He also replied to the assertions that if the trigger were full before the block was closed it would fire the cartridge, and that the empty case would be ejected into the face of the rear rank men. In answer to the objection opposed to the use of the spiral spring, he said that this contrivance had been adopted by the French and Prussians, and it was the only part of the Chassepot and needle-guns which was not to be altered. The bayonet to be employed with the rifle was the saw-bayonet, which was at present used by the Royal Irish Constabulary. This would be useful not only as an ordinary bayonet, but also as a saw and a *couteau de chasse*.

NEW AMERICAN BREECH-LOADER.

A NEW breech-loader, the invention of a New-Yorker, has been tried at Springfield Arsenal before a party of spectators interested in firearms. A local paper says of the invention:—It introduces a new principle in weapons of this kind, and is said by experts to comprise their excellencies and to overcome many of their disadvantages. The essential feature of the new gun is in the mechanism of the lock, which entirely does away with the old-fashioned lock or hammer, and substitutes in its place an ingenious yet simple contrivance, which fixes the cartridge and discharges the shell from its chamber with great rapidity and absolute certainty. This "unit lock," as it is called, is in one piece, and has no complicated screws or machinery liable to get out of order or embarrass the operator. There are, besides, other important features, such as a graded raised sight, fitted upon ratchets, which would seem to increase the general efficiency of the arm. This invention was perfected the present year; but it has already been tested by the Prussian, Belgian, and Austrian Governments, and the official reports of these trials speak in high terms of the new breech-loader, as do also those at the armoury here who have seen and examined it. The trial was considered generally satisfactory. With the Remington cartridge accurate shots were made at 200, 500, and 700 yards distant, and in quick firing ten shots were discharged in twenty seconds, and twenty shots in fifty-two seconds. The inventor claims that twenty-five shots can be fired in a minute with more than ordinary accuracy.

VELOCITY OF PROJECTILES.—QUICKER THAN THOUGHT.

ONE of the most remarkable objects at a recent meeting of the Institution of Mechanical Engineers at Newcastle was the new Chronoscope, for measuring the velocity of a projectile within the bore of a gun, the invention of Captain A. Noble, late R. A., now of the firm of Sir William Armstrong & Co. This wonderful instrument is capable of measuring portions of time so minute that the human mind is as unable to realise them as it is to grasp ideas of infinity. To most of us, a second of time seems to pass very rapidly, and a clock denoting tenths of seconds is looked upon as a most accurate instrument. What shall we then say to a machine capable of dividing a second into a million parts?—to an instrument where the inaccuracy of the thousandth part of a second would be a greater comparative error than the loss of an hour a day by an ordinary watch? The Chronoscope consists of six brass discs, each 36 in. in circumference, and about $\frac{1}{8}$ in. thick. These are firmly secured to a spindle or axle, which is geared to a train of wheelwork, the whole being driven by a weight something similar to a clock weight. Each wheel travels five times as fast as the one immediately preceding it, so that a very rapid motion of rotation is imparted to the discs, the rate of speed being measured by a clock or stop-watch attached to one of the slower-moving wheels. When the instrument is in full spin the discs are revolving at a rate of about 28 times in one second, and as they are 36 inches in circumference, an inch of disc corresponds to about the thousandth part of a second, the tenth of an inch to the ten-thousandth part of a second, and the thousandth of an inch to the millionth of a second. The instrument is provided with a graduated scale, vernier and magnifier, by which the thousandth of an inch is read off. The passage of the shot in the bore of the gun is recorded on the edge of each disc by a tiny electric spark derived from a Rhumkorff coil. A brass discharger is fixed in an ebonite plate; opposite each disc wires pass from this through an electric battery and coil to the gun, where they communicate with the interior of the bore by means of screw plugs in the side of the gun. The shot cannot pass out of the bore without cutting the wires thus communicating with the inside, and as each wire is cut a spark is emitted from a discharger, and the edge of the corresponding disc receives a mark on some prepared paper with which it is covered. Thus, let us suppose the gun to be fitted with six plugs each two inches apart, the first being in such a position that when the gun is loaded the front part of the shot just touches the first wire. The instant the gun is discharged the shot begins to move, and so breaks the first wire and marks the first disc; it then breaks the second wire, and marks the second disc, &c., until it finally breaks the sixth wire, and marks the sixth disc. While, however, the shot was passing from the first to the sixth wire the instrument was revolving, and the sparks,

instead of being in a straight line on the discs, will appear in echelon, the distance between each of them corresponding to the time taken by the projectile in passing from wire to wire. This most ingenious instrument has been in use for some time at Woolwich, and has been extensively used by the special committee on explosives during their experiments on the pressure of fired gunpowder of various descriptions in the bores of heavy guns.—*Globe.*

THE PALLISER GUN.

In 1866 eight cast-iron 24-pounder and 32-pounder smoothbore Guns were converted by Major Palliser into 56-pounder and 64-pounder rifled guns, with a view of ascertaining whether our large stock of cast-iron guns could be advantageously converted into rifled cannon. Of these eight experimental guns one was tested for endurance, by firing continuously, with shot of 64 lb. weight, until it had completed 2,285 rounds, of which 2,170 were with 8 lb. charge, 88 with 14 lb., 2 with 12 lb., 1 with 10 lb., and 24 with 16 lb. and 86 lb. shot. The power of endurance of the converted guns was thus thoroughly proven. Six of the remaining guns were issued for service to home and foreign stations, in order that the Royal Artillery might have an opportunity of practising with them. The preliminary reports from these stations have now arrived, and are, on the whole, very satisfactory. The 64-pounder issued to Devonport has fired over 300 rounds, the gun is reported to be perfectly serviceable, and no complaints have been made of any difficulty in working. The Sheerness 56-pounder gun has fired 200 rounds, and the practice is reported as excessively accurate. The report from Gibraltar speaks in high terms of the accuracy of the 56-pounder issued to that station. The gun fired 400 rounds, and is perfectly serviceable. The 56-pounder issued to Malta fired 250 rounds. At Dover a 64-pounder has fired over 180 rounds with remarkable accuracy. The gun is spoken of as being, for handiness and fitness for rough work and exposure, in every way equal to the old 32-pounder. The 64-pounder on board the *Excellent* has fired over 480 rounds with great accuracy, the working of the gun, carriage, &c., being in every way satisfactory. These reports are of much interest, proving, as they do, that the converted 64-pounder gun is fully equal to the more expensive wrought-iron gun of the same calibre.—*Globe.*

THE TITANIFEROUS IRON-SANDS OF CANADA.

At the Lyceum of Natural History, New York, Professor Eggleston has mentioned the Moisic iron as being of excellent quality, being in toughness, purity, and fibrous structure, as fine as any in the world. A railroad axle, $2\frac{1}{2}$ in. to 3 in. in diameter, made from this iron, was bent up cold; a stout bar, 2 in. thick, twisted till it looked like a corkscrew, and could be twisted no longer;

and it had been submitted to other tests, all of them signally demonstrating the superiority of this iron. The greater was his astonishment on learning that it had been manufactured from the titaniferous iron-sands, occurring at the mouth of the St. Lawrence, at the Moisic Iron Works, under the superintendence of Mr. Molson. Here are two novelties; for, in the first place, the manufacture of iron from any sands had never before succeeded, as such finely comminuted material would choke up the furnace, or sift through the charge without undergoing reduction; in the second place, these sands had the additional drawback of containing 12 to 20 per cent. of titanic acid. The sands are worked in a bloomery furnace, the tuyère, however, entering not at an angle, as is usually the case, but almost horizontally, increasing the zone of reduction. All of the titanic acid present goes, as such, into the slag (which shows a remarkable tendency to crystallise and gelatinise with hydrochloric acid), while the magnetite present is reduced, and furnishes the finest iron. The question whether this process will be pecuniarily successful will soon be decided by experiments now going on.—*Mechanics' Magazine.*

IRON SMELTING.

Mr. Isham Baggs has patented a method of Smelting Iron by means of inflammable gases or the vapour of petroleum, which are blown into the furnace. But petroleum has been proposed for this purpose before, as also have been the gases obtained from coal. In purifying the iron from certain contaminating ingredients, Mr. Baggs proposes to blow hydrofluoric acid through the melted metal. But this also had been previously suggested.

In a paper read by Mr. C. Cochrane, of Dudley, before the Institution of Mechanical Engineers, it was pointed out that, taking the maximum limit to the size of a blast furnace to be that at which the temperature of the waste gas evolved from the furnace-top will have become cooled down to the temperature of the external atmosphere by its passage through the materials, it would not be beneficial to employ a greater capacity of furnace than two-and-a-half times the capacity of the largest Cleveland furnaces of 20,000 cubic feet, supposing the ore to contain 40 per cent. of iron, and the blast to be delivered at a temperature of 1,000 deg. This conclusion, however, will manifestly be affected by the rapidity with which the heat escapes through the sides of the furnace; and in the case of a furnace with a flame-jacket it would not apply. The phenomena of dissociation show that furnaces may be made too hot, as well as too cold, and that the pressure of the blast should be high.

A new method of producing wrought iron has been patented in America by Francis Ellerhausen, and is, we believe, about to be tried at Dowlais and some other ironworks in Wales. A large turn-table, fitted with cells or boxes, is rotated by an engine in

tread of a spout of molten cast iron and a spout of pulverised hematite, the effect of which arrangement is to deposit a layer of cast iron about $\frac{1}{8}$ in. thick, and a layer of pulverised hematite of the same thickness in each cell; forming together a plate or slab of wrought iron $\frac{1}{4}$ in. thick and weighing about 100 lb. These slabs or tiles are then broken up in a puddling furnace, and, after a short exposure, are treated as common wrought iron. Such a method may answer when the ore is very pure. Nevertheless, it is doubtful whether, even in that case, it is the most economical system that could be adopted, as the hematite should be convertible without using cast iron at all.—*Illustrated London News.*

IRON AND STEEL INSTITUTE.

At the first meeting of this Society the Duke of Devonshire, the president, delivered a lengthy and exhaustive inaugural address. His Grace explained the objects of the Institute, which are to afford a means of communication between members of the iron and steel trades upon matters bearing upon the respective manufactures, excluding all questions connected with wages and trade regulations, and to arrange periodical meetings for the purpose of discussing practical and scientific subjects bearing upon the manufacture and working of iron and steel. He reviewed the success which had attended the formation of scientific and agricultural societies, and saw no reason why equal advantages should not accrue to the iron trade by association. Then his Grace passed on to review the early history of iron, the manufacture of which was mentioned by Homer and Hesiod, and had been asserted by Mr. Layard to have been known in Assyria in 900 B.C. He then noticed the early methods of manufacture down to the period of the use of coal, which gave such a vast impetus to the manufacture of iron in this country, and afterwards referred to the invention of the "hot blast," the increased supplies of ore, and other causes which had contributed to the present importance of the iron manufacture. The processes by which pig iron, malleable iron, and steel are manufactured having been alluded to, the president referred to the utilisation of the waste of gases from the blast furnaces, and went on then to show how the raw material and manufacture were distributed over the world. The problems to be solved now, which were of the most importance, were economy in the consumption of fuel, and a greater utilisation of the waste gases. Mineral oil had been used in the dockyards in place of coal. It was also highly important to obtain the metal as pure as possible, and though chemistry had been brought to the aid of the manufacture, yet the chemistry of iron and steel was still, in many respects, obscure and uncertain.

BESSEMER STEEL

THE approaching termination of the Bessemer royalties on cast steel will probably have the effect of reducing the price of steel rails to £9 per ton, and steel, it may be expected, will henceforth be used for many purposes for which iron has heretofore been employed. By the Bessemer process the cast iron is first decarbonised and converted into wrought by blowing a stream of air into the melted metal, and the wrought iron is turned into steel by the introduction of a definite quantity of cast iron, which supplies the carbon required This process, however, for the production of steel has been practised in India from time immemorial The use of manganese in the manufacture of steel has also been derived from the same source.

ROLLING THICK ARMOUR-PLATES

THE difficulty experienced in Rolling Thick Armour-plates of considerable width appears to have been successfully overcome at the Atlas Works, Sheffield, by the simple process of rolling the pile crossways as well as lengthways until it becomes of the required dimensions, the great difficulty of heating uniformly very wide masses of metal being thus abolished Mr Ellis, the managing director of the Atlas Works, expressed himself strongly as to the great difficulty of heating plates of any considerable width, before the Gibraltar Shield Committee in January of last year, and Lieut English, of the Royal Engineers, subsequently hit upon the method above mentioned In a letter, dated March 11, 1868, published in the addenda to the Report of that Committee, he describes the plan, and mentions his having suggested it on March 3 to the managing director of the Atlas Works By the report of the first successful experiment, it appears that the process has since been patented by Mr. Ellis.

ARMOUR-PLATED SHIPS

MR. J M HYDE has read to the United Service Institution a paper "On Deflecting Armour plated Ships for Coast Defence" The lecture was illustrated by two admirable models, and a series of experiments made with model gun, shot, and targets, all alike on a scale of one inch to a foot, the model 600-pounder having thus a bore of exactly one inch, and the six, nine, and twelve-inch targets being equally represented by half inch, three-quarter-inch, and one-inch plates The system of plating shown in Mr Hyde's models may be regarded as an iron glacis at a slope of 22½ degrees around the entire deck, the one model having plated chambers at each end, bow and stern, the other having a plated casemate in the centre The armour forms an overhanging knuckle all round the ship, the horizontal edge of which is the only portion facing directly the line of fire from an

enemy's guns, and this portion presenting with 4 in. armour-plating a depth of 18 in. to the enemy's projectiles. The series of experiments with the model gun and targets were exceedingly interesting, as showing the defensive value of angulated armour, and remarkable deflections of shot with ogival heads, particularly so when a wood facing was placed in front of the iron armour, the shot in this case turning out again by ricochet without touching the plate itself. A plan for the conversion of wooden ships by the addition of Mr. Hyde's armoured sponsons was also submitted. In Mr. Hyde's system, it will be understood, the ship has no vertical wall whatever. The paper was discussed by Captain Beamish, Mr. Wilson, and other gentlemen, the chairman expressing a high opinion of the value of deflecting armour for ships of war.

UNARMOURED WAR FRIGATES.

Her Majesty's Screw Frigate *Inconstant*, 4,066 tons, iron built, with an outer sheathing of wood, unarmoured, 1,000-horse power nominal, 16 guns, is a bold, handsome-looking frigate, with a bow as long and fine, proportionately to tonnage, as that of a racing cutter. Her stern lines are not so pleasing in the present "sit" of the hull upon the water, but this appearance may be entirely reversed, and give as much promise of speed as the bow lines when the frigate has all her weights on board and is brought to the trim of her load water draught. Her rig is full and handsome.

As regards the structural arrangements of the *Inconstant*, it may be said that she is really a completely built iron ship cased with wood; and has all the internal arrangements—bulkheads, watertight compartments, &c.—common to well-built iron ships of war of the present day. Outside the iron skin of the hull there are two layers of wood planking, which are fitted and fastened in a manner that reduces the chances of any galvanic action to all but an impossibility. Unusual pains appear to have been taken with this part of the ship's construction. The copper sheathing is nailed to the outer surface of the wood planking in the ordinary manner, and as special care is taken that there shall be no connection, direct or indirect, between the metals, there cannot be any galvanic action and consequent wasting of the iron of the ship's bottom. The copper sheathing keeps the bottom of a ship, as is well known, comparatively clean for a long period; while the bottoms of ordinary iron ships, especially when in tropical waters, very rapidly become foul, however much they may be painted over with preservative paints and anti-fouling compositions. The reduction of the speed by a knot or two per hour on account of the foulness of bottom is by no means an unusual occurrence with iron ships which make distant voyages; indeed, the adoption of the composite system of building in the construction of the tea clippers which annually race to the Thames from China is due to this fact. In a ship like the *In-*

constant, then, where considerable sacrifices have been made in order to ensure great speed, it obviously was of the greatest importance to prevent any decrease in that speed being caused by foulness of bottom; and any trouble or expense bestowed upon the ship in sheathing her for the preservation of her speed over lengthened periods out of dock has been well applied. Between the American ships and the *Inconstant* there is this important difference also in their construction—the former are built throughout of wood, and the latter of iron. The question may be asked—"Why not have built the *Inconstant* of wood, when it was intended that below the water-line she should be sheathed with copper?" No better answer could be given to such a question than is to be found in the reports forwarded to the Navy Department at Washington from these American unarmoured flying wooden-built cruisers. In all, or nearly all, of these vessels that have yet been tried signs of weakness have appeared, which are simply due to the excessive strains caused by the exertion of great engine power in wood-built vessels of such extreme length and fineness. The *Guerrière*, according to a reliable statement, proved so weak after a cruise of some 3,000 miles that she required to be thoroughly re-caulked. Such a ship could not long continue on active service; and for a seagoing cruiser, intended to remain for a considerable period away from port, these constantly recurring weaknesses would seriously detract from her usefulness. It was probably this weakness as a wood-built ship which prevented the full exertion of her engine-power on the occasions referred to in the South Atlantic, and thus gained for her the reputation of being to a certain extent a failure in speed under steam. With the great strength of the *Inconstant's* iron hull her engines may be driven at their *maximum* rate of speed as often as may be required, without fear of any damaging effect upon any part of the ship.

On the whole, then, and according to present lights on the subject, the *Inconstant*, built, engined, armed, and rigged as she is, approaches very closely the *beau idéal* of an unarmoured war frigate. For the most distant voyages, for rapid chase or flight, or as a convoy to merchant shipping, she can scarcely fail to prove a most efficient vessel, and it is a matter for much regret that the *Volage* and the *Active* have not been built, as it was originally intended they both should have been, of the same dimensions, and thus enabled to perform equally important services.—*Times*.

HER MAJESTY'S SHIP "MONARCH."

THE *Monarch*, Armoured Iron-built Turret Ship, 7 guns, 5,102 tons, 1,100 horse-power of engines (nominal), is a ship that must be of considerable interest to the general public, inasmuch as she represents official ideas of some three years ago, on the description of vessel that could only satisfactorily represent an ocean cruising turret ship, and in this respect has been designed and constructed

as the competitive ship with the *Captain*, designed and building by Captain Coles and the Messrs. Laird, at Birkenhead. The form of the *Monarch* below the water line is indisputably the best proportioned in its curves, and more conducive to high speed, than that of any other ironclad that has yet been sent afloat by the present Chief Constructor, and the promise of speed which it gave was fully confirmed by the exceptionally high rate of 14·937 knots per hour, obtained by her, as a mean.

She is essentially a turret ship with a high freeboard, the latter being 14 ft. above the water line, and is topped by a (lowering) thin iron-plate bulwark, about 3 ft. in depth. From the sides inwards to the centre the upper deck is somewhat curved, and the guns in the turrets are thus carried, with the axis of their bore, about 20 ft. above the water. In this great height above the water line of the hull of the vessel and all it carries above-board, the eye is struck with the great amount of target surface exposed to shot, but this part of the question of the fitness of the *Monarch* for turret warfare at sea can only be decided by the experimental trials between her and the *Captain* (the *Captain* has barely half the freeboard given to the *Monarch*), and must therefore remain an open one for the present. There is, however, no manner of doubt that the Chief Constructor of the Navy, and the Controller, Captain Coles, and the Messrs. Laird, have all now very much greater faith in moderately low freeboards for ocean cruising turret ships than they had three years ago. The turrets of the *Monarch* are surmounted by a roomy hurricane deck, which extends from just abaft the foremost and forward of the main hatchway. To this deck independent and funnel-like hatchways lead up from between decks. The two turrets which the ship carries are fixed as near as possibly together between the foremast and mainmast, and with the funnel, or "smoke-pipe," between them. Each turret has an outer diameter of 26 ft. 6 in., and internally is 22 ft. They are plated with 10-inch armour in solid rolled plates round the ports, and with 8-inch on other parts. In each turret is mounted on compound pivoted iron carriages and slides, two 25-ton muzzle-loading rifle guns of 12-in. bore and 15 ft. in length. They are exactly balanced at the trunnions, and throw a 600-pound shot with a battering charge of 70 lb. of powder. In the ordinary position of the guns in the turrets they have seven degrees of depression and four degrees of elevation. Lowered down to the next position, or "step," as it is technically termed, they have half a degree of depression, and 9 deg. of elevation. Lowering them still further, and into the deepest position in the turrets, the guns would then have 16 deg. of elevation, such as would be given to them in throwing shells into a loftily-planted fortress. The guns are raised and lowered in the turrets by hydraulic power and by screws. There are four sets of sights to each gun. The time occupied in lifting the guns from the lowest to the highest step in the turret is three and a half minutes, or at the rate of six inches per minute. Both

turrets are based on the main deck of the ship, but all the turning gear is on the deck below. One set of steam gear and two sets of hand gear are fitted to each turret for turning it. In addition to the turret guns the ship carries five six-and-a-half-ton guns at the extreme ends, firing through armour-plated bulkheads. The steam-engines for turning the turrets have been constructed from drawings prepared at Chatham dockyard. They have no link motion, and are as wonderfully equable in their working as they are effective. Inside the turret one man at a lever handle gives the turret direction and at the same time regulates its speed. The steam capstan is driven by a similar engine arrangement.

The side sights have reflecting mirrors, so that the object fired at with "depression" can be seen in them. The other sights are for firing with elevation.

The *Monarch* is full and, for an ironclad, heavily rigged, and this no doubt adds to the favourable appearance she makes afloat when lying in an open space such as Spithead. That she will steam satisfactorily has been sufficiently proved; that she will sail moderately well, with the large area of canvas she is able to spread, may be reasonably expected; and that she would fight a good action with any other ship is certain, with the enormous ordnance she carries in her turrets, although her high sides might suffer from an enemy's turret fire. Under a full head of steam, if pressed at any time against a head sea, she would undoubtedly be a "wet" ship, nor would her high freeboard at all help her to prevent the seas dipping in pretty freely over the bows. Fast steaming ships of war must, however, be reasonably expected to be wet ones, and many authorities contend that the natural position for the hull of a turreted vessel is to have at the least eight-tenths of it immersed in still waters, and wholly so at sea.

In conclusion, it is necessary to observe that the engines of the ship have given the greatest satisfaction by their work throughout the trial to the Admiralty officials on board. Messrs. Humphreys and Tennant are the makers, and they were represented on board by Mr. Robert Humphreys, Mr. Allfrey, and Mr. Langdon. The engines have a combined nominal power of 1,100 horse. The cylinders have an effective diameter of 120 inches, with a piston stroke of 4 ft. 6 in. They have return connecting rods, with four pistons. The boilers have 19 ft. of surface per nominal horse power. The screw is a two-bladed "Griffiths," having a diameter of 23 ft. 4 in., a pitch of 26 ft. 4 in., a length of 5 ft. 2 in., and an immersion of upper edge of 16 in.

The diagrams taken by the officials on board during the trial gave the indicated power of the engines as 7,842 horse.—*Times.*

HER MAJESTY'S TURRET-SHIP "GLATTON."

THERE is now under construction at Chatham Dockyard the most powerful Turret Ship yet built—the *Glatton*—from the

designs of Mr. E. J. Reed, C.B. This will be the first vessel built by the Admiralty on the pure turret principle, with an exceedingly low freeboard, or height of her sides out of the water. She will be constructed with a single turret, in which will be placed a couple of 25-ton guns. The thickness of the armour-plating on her sides will be no less than 12 in. above the water-line, and the remainder 10 in. in thickness, worked to a teak backing of 20 in. The inner skin plating to which the timber backing is attached consists of two thicknesses, each one inch thick, laid on the usual iron frames 10 in. deep, placed 2 ft. apart. The total thickness of the iron and teak of the *Glatton's* sides will thus be 3 ft. 8 in. The armour-plates on the turret will be no less than 14 in. in thickness in the most exposed parts, and 12 in. thick in the remainder, worked on a backing of teak of 15 in., with two thicknesses of skin plating $\frac{5}{8}$ in. each. The entire base of the turret is enclosed by a breastwork carried to a height of 6 ft. 6 in. above the deck, the whole being covered with armour-plating 12 in. in thickness, laid on a backing of teak of 18 in. thick. The turret guns will fire over the breastwork, the *Glatton*, when in action, having a freeboard of only 2 ft., measured to the deck, the turret guns being exactly 11 ft. 6 in. above the water line. Like the whole of the other iron vessels designed by Mr. Reed, the *Glatton* is constructed throughout on the double bottom unsinkable principle, the space at the armour-shelf being increased to about 4 ft., giving, with the overhang of the armour and backing, a projection of about 6 ft. 6 in. When not in action her mean draught of water, forward and aft, will be 19 ft., but she can be submerged to any depth by means of water ballast, pumped into tanks specially fitted for this purpose. Stowage accommodation is provided for 250 tons of coals in her ordinary bunkers, but this quantity can be increased to between 500 and 600 tons by using the water-ballast tanks for stowing the coals. She is to be fitted with engines of 500-horse power (nominal), but capable of working up to 3,000-horse power (actual), and her estimated speed will be from 9½ to 10 knots per hour.

THE IRON TANK MOLASSES BRIG "NOVELTY."

THE *Novelty* was built at the Atlantic Works, East Boston, and is fitted with square iron tanks to carry Molasses in bulk. She had her tanks filled with water when she left for Cuba, by way of experiment, to see how she would work with a liquid cargo, and also to test the tanks. On her arrival at Matanzas her tanks were pumped out in a single day, and the vessel was then ready to receive cargo, which she took on board at the rate of 200 hogsheads per day. The cargo of the *Novelty* consists of 84,075 gallons, to be pumped by steam-power from the vessel into pipes connecting with an iron tank at the Oxnard Sugar Refinery. It is calculated that when the cargo is all ready at the point of shipment, it will require only four days to load her

when it is received from lighters, and under favourable conditions the round voyage can be performed in 30 days. The saving by the use of tanks is estimated at about $2,000 on the cargo of the *Novelty*. The success of this experiment is due to the enterprising firm of Messrs. Nash, Spaulding, & Co., who have persevered against many obstacles before reaching the present successful termination of their efforts. The greatest difficulty to overcome was to allow for fermentation, which is usually equal to ten per cent. To ensure safety it was necessary to keep the tanks full, or otherwise the rolling of the vessel would destroy them by the swashing of the molasses; so over each tank a turret was constructed, holding about twelve per cent. of the cargo, and when the article was in a fermented state it would naturally rise to the turret, a hole in it being made for the purpose, and when it subsided it would fall. Thus by having molasses in sufficient quantity in the turret, it ensured a full measure for the tank.

GOLD CURRENCY.

THE Master of the Mint and the late Master of the Calcutta Mint have reported to the Chancellor of the Exchequer upon the question of the mintage necessary to cover the expenses of establishing and maintaining the Gold Currency. The gold coinage in circulation in the United Kingdom is generally estimated at about 80 millions sterling, 68-80ths being sovereigns and 12-80ths half-sovereigns. An estimated annual coinage of about 10 millions would be made up of 4 millions of first coinage and 6 millions of renewal. The cost at which a sovereign or half-sovereign is produced may be safely taken at about a halfpenny. By wear, sovereigns fall below the legal weight after a circulation of eighteen years, and half-sovereigns in ten years. Mr. Jevons calculates the annual loss by wear on 100 sovereigns at 8·371*d.*; on our present mixed circulation of sovereigns and half-sovereigns the annual loss is calculated at £35,000. Some coins drop out of circulation annually by shipwrecks, fires, melting, losses, &c., and, on the other hand, it is estimated that there are about 30 million sovereigns in circulation in foreign countries, part of which may be returned to the United Kingdom for renewal when they become light. The result of the whole calculation is that, for our circulation of 68 million sovereigns and 12 million half-sovereigns, an endowment of £1 13*s.* 6*d.* for every £100 would suffice for the permanent maintenance of the coin, the first construction, and all future restoration. These results are based upon the mere bullion by itself, and are quite independent of all other considerations.—*Mechanics' Magazine.*

GILDING AND BRONZING.

BÖTTGER tells us how a golden appearance may be given to steel pens, which may not be new to all our readers, and which is so troublesome that the result could hardly pay. The

pens are first coated with copper by means of a battery and the ordinary cyanide solution. Then a very thin coating of zinc is given by the use of a weak battery, and a moderately strong solution of sulphate of zinc. The pens are then scoured with chalk and water, rinsed and dried, and afterwards thrown into boiling linseed or cotton seed oil, where, in a few minutes, they assume a colour closely resembling that of gold. Böttger tells us that the colour comes at about 350 deg. Fah. The pens have now to be cleansed from the oil, which everyone knows how to do.

The same industrious technologist gives a simple bronzing process applicable to porcelain, stoneware, and composition picture and looking-glass frames. The articles are first done over with a thin solution of water-glass by the aid of a soft brush. Bronze powder is then dusted on, and any excess not adherent is knocked off by a few gentle taps. The article is next heated, to dry the silicate, and the bronze becomes firmly attached. Probably, in the case of porcelain, biscuit, or stoneware, some chemical union of the silicate will take place, but in other cases the water-glass will only tend to make the bronze powder adhere to the surface. After the heating, the bronze may be polished or burnished with agate tools.—*Mechanics' Magazine.*

THE MANUFACTURE OF PINS.

About the middle of the last century the Ryland family introduced into Birmingham the two new industries of Wire-drawing and Pin-making, which at that period were regarded as twin handicrafts. After a steady development of five-and-twenty years the pin trade was transferred to an ancestor of the present eminent firm of Thomas Phipson and Son. A few years since every schoolboy's manual contained a sketch of the operation of pin-making as a remarkable instance of the division of labour. A single pin had to undergo the manipulation of not less than 14 pairs of hands before it was ready for the cushion in my lady's boudoir. This forcible illustration no longer applies. Pin-making, like other industries, has been subject to the scientific progress and improvement of the age, and the process is now comparatively simple. An American engineer named Wright patented in 1824 a pin machine which, during the revolution of a single wheel, produced a perfect pin. Mr. Thomas Phipson thus describes Wright's machine, which, having undergone many improvements, is now in operation at the factory of the former here:—The principal shaft gives motion in its rotation to several sliders, levers, and wheels, which work the principal parts of the machine. A slider pushes forward pincers, which draw wire from a reel at every rotation of the shaft, and advance such a length of wire as will produce one pin. A die cuts off this length of wire by the descent of its upper "chap," and the latter then opens a carrier which takes on the wire to the pointing apparatus. Here it is received by a holder, which

turns round while a bevel-edged file-wheel, rapidly revolving, gives to the wire its rough point. It proceeds immediately by a second carrier to a second and finer file-wheel, by which the pointing is finished. A third carrier transfers the pin to the first heading die, and by the advance of a steel punch one end of the pin wire is forced into a recess, whereby the head is partially produced. A fourth carrier removes the pin to a second die, where the heading is completed. When the heading bar retires a forked lever draws the pin from the die and drops it into a receptacle below. It is then ready to be "whitened" and "stuck." The whitening is performed in a copper vessel placed on a fire, in which the pins are boiled in water along with grains of metallic tin and a little bitartrate of potash. When the boiling has continued for about one hour the pins and tin grains are removed, thoroughly washed, dried, and polished in bran. Various kinds of apparatus are employed for sticking the pins into sheets of fluted paper, and also for folding the paper for the wrappers.—*Engineer.*

BRASS CHAINS FOR GASELIERS.

Dr. Percy, in a letter to the *Times*, points out the danger which occasionally arises from the use of Brass Chains for suspending gaseliers, as a subject on which, during many years, he has been collecting information. Dr. Percy has seen brass wire, about an eighth of an inch thick, after having been subjected to occasional vibration while stretched, become so tender and brittle in the course of a few weeks as to be capable of being easily broken into short pieces between the fingers. He has also seen the links of brass chains, which have been employed in suspending gaseliers, undergo a similar change, though in a less degree. These effects, so far as Dr. Percy has observed, have been due to spontaneous physical changes in the metal, and not to atmospheric corrosion. It is well known that other alloys undergo singular spontaneous changes. Brass which has become tender and brittle may, by annealing, be rendered as tough and flexible as at first. It appears that only certain varieties of brass are liable to be thus affected; and, if so, the explanation will probably be found in the presence of foreign matters in small proportion. Dr. Percy has never seen copper become tender and brittle like brass.

HOW A FRYING-PAN IS MADE.

In the *Engineer* is given the following account of the manufacture of this article. The disc plate is first heated, and then placed on the "bed"-die of the first of three stamping-machines ranged in a row. The stamp is next released, and the disc receives its first impression, the required shape being completely attained by the two succeeding stamps. To restore the toughness of the iron—impaired somewhat by these three violent

operations—and also to prepare it for the subsequent operation of tinning, the pan is reannealed, and then subjected to a systematic process of hammering, in which the hammer is made to fall with the greatest possible uniformity so as to ensure a perfectly smooth and regular surface. This process requires a good deal of tact and agility in manipulation, and can only be successfully performed after long experience on the part of the workman. The "stripping" or paring of the rim is the next operation, by which all roughness of the outer edge is removed, after which, by a sort of scraping process, all particles of oxide are taken away. A second "hammering" is then effected before the pan is transferred to the "mounting shop." Here a forged iron handle—made of Staffordshire rods—is riveted on, and the frying-pan is then ready for the final process of tinning. The tinning shop is, as a rule, a large and well-ventilated building, fitted up with a number of vats containing sulphuric acid, and "baths" filled with molten tin. The dipping of the article to be tinned into the sulphuric acid—or "pickling"—thoroughly cleanses it, and it is then ready for immersion in the tin "bath," which effects the required coating, and renders the article ready for use.

KEEPING BEER ON DRAUGHT.

A VERY ingenious plan of Keeping Beer on draught completely excluded from air has been devised by Mr. Taylor. It dispenses altogether with the use of casks. A slate cistern is let into the ground, by which at once the advantage is obtained of keeping the beer at a nearly uniform temperature at all seasons of the year. But, as we have said, the chief feature is the complete exclusion of air. This is effected by the use of a floating lid, which, of course, descends as the beer is drawn out. The manner in which the lid is made to fit accurately to the walls of the cistern, and still is free to descend, could only be made clear by a drawing. But we may say that a wooden lid is made to fit very nearly to the sides. The sides of the wood are bevelled, so that only a narrow edge is presented to the walls of the cistern. Along this edge a band of canvas or india-rubber is fixed, which gives, with the bevel on the upper surface, a V-shaped space, and by packing this space with wet sand, or some soft material, the canvas or india-rubber is kept in close contact with the walls of the tank. Thus, the liquid within is completely sealed from all access of air. In order to draw out the beer, the centre of the lid is bored, and provided with a stuffing box arrangement. To tap it, a perforated pipe is thrust through the stuffing box, and the connections to the beer engine are made in the usual way. This pipe deserves some notice. It is closed at the bottom and for an inch or so up, so that, when the lid descends to the bottom, any sediment in the tank is avoided. In this way, the beer is always drawn bright and clear. The advantages of totally excluding air from beer are very great, both to brewer and publican, whose greatest loss is made by

beer turning sour, which will be entirely prevented by the use of this apparatus. There will be an enormous incidental saving in the cost of casks. Besides that, all the dangers of foul casks are avoided. For publicans who brew their own beer, the plan offers peculiar advantages, for the tanks will serve as fermenting vats, and, besides that, they need not have a cask in their establishment.—*Mechanics' Magazine.*

BREWING PRESS.

A PRESS for squeezing wort out of hops has been erected at Messrs. Truman's brewery, consisting of two endless chains arranged at an angle with each other, so that any substance placed between the two chains will be gradually compressed as the chains advance. An American apparatus for compressing and cutting tobacco, constructed upon this principle, was shown at the Paris Exhibition in 1867. The tobacco was put into a box, the bottom of which was formed of a travelling web of cloth, and this web delivered the tobacco on to a travelling chain-web, formed of two endless chains connected with cross bars. A similar chain-web was carried above the tobacco, but at a different angle, and the ends of the cross bars moved in grooves formed in stout side frames. As the tobacco was moved forward it was gradually compressed between the cross bars of the respective webs and was delivered at the end through a square hole in so compressed a state that it was easily cut by scythes rotating in the front of the delivering orifice. The species of hop-press erected at Messrs. Truman's brewery resembles this tobacco-cutter, except that it is without the rotating knives; but the means employed for giving the requisite pressure continuously are the same.—*Illustrated London News.*

BALLOON EXPERIMENTS.

IT will be remembered, that in 1868 an attempt was made to execute aërial trips in the metropolis, surpassing the ascents that have been made on the other side of the Channel; but an accident put an end to it in the very beginning,—the Balloon in question having been destroyed by fire. A new one has since been constructed, on the same plan, only larger and stronger, at an expense of £20,000. It ascends, weather permitting, to a height of 2,000 feet, from a vast circus, constructed of wood-work and canvas, on grounds adjoining Ashburnham House. The car is able to carry thirty persons, with 2,000 lb. of ballast, and an immense guide-rope, ready to afford aid in case the cable might be broken by a sudden gust of wind. An accident of this kind —which, however, may be considered impossible—would change the captive balloon into a free one, and blow the passengers to a distance of some hundred miles in half-an-hour. The greatest inconvenience would be felt by the gazers below, who would

possibly be cut into more than two by the fall of the big cable, which is upwards of two tons in weight.

A private trial trip for special scientific purposes took place on May 5, 1869, when Mr. Glaisher, the great air-explorer of the age, went up with Mr. Yon, the director of the balloon, and several other French aëronauts; the expedition, which was a tentative one, being joined by Mr. Karl Blind and a few other gentlemen. The wind-pressure on that day was extraordinary, varying from 6,000 to 12,000 lb.; and the spectacle of the gyrations of the balloon, with its appendage containing a human cargo, was magnificent. The force of the wind and the strain on the cable being found so great, it was thought advisable to make a rope of descent, followed by a second attempt when the state of the atmosphere seemed to have bettered. The balloon, going up to an altitude of 1,500 feet, deviated some 500 feet, through a strong westerly current. The meteorological observations taken were of considerable importance.

On May 10 the wind-pressure reached to 12,400 lb., when the engines working the pulley had to go up to 4 atmospheric pressure, which gives a real traction force of 60-horse power. For the first time the weather was then clear, and the passengers were able to see, at a glance, Westminster Abbey, Kensington Museum, London Bridge, Harrow-on-the-Hill, the Crystal Palace, &c. Small clouds, coming from the west, were visible on a level decidedly lower than the horizontal line of the car. A meteorological observatory is now in course of being established on board, which will be conducted under the honorary supervision of Mr. Glaisher. The readings will bear upon the aneroid and the mercurial barometer, the wet and the dry bulb thermometer, the blackened thermometer, and the blackened thermometer *in vacuo*. Messrs. Negretti and Zambra have constructed an anemometer for registering high level winds. Experiments will, moreover, be tried to ascertain the force of the air electricity. Professional aëronauts are being trained to the difficult art of taking readings accurately; and the best form to be given to the instruments is under the consideration of competent persons. Every reading will be entered in a book of reference, the contents of which will be computed and subjected to proper reductions and calculations.

It would be useless to attempt anticipating the results of a series of observations which are just beginning, and which it requires much care and ability to conduct in a satisfactory manner. But it may be allowed to insist on the importance of experiments executed on so large a scale with so much daring. The balloon used for the purpose is the largest in existence, and has proved its capability to hold the pure hydrogen during more than fifteen days, which had hitherto been deemed an impossibility. The working of the apparatus is conducted by Mr. Yon, one of the aëronauts who took part in Nadar's expedition from Paris to Hanover. He is assisted by Mr. Godard, whose name

is well known. The inventor and proprietor, Mr. Giffard, the patentee of the "injector," is desirous of studying the art of ballooning with a view to the application of a regular motive power, the invention of which would be the "crowning glory."—Wilfrid de Fonvielle.—*Athenæum.*

THE VELOCIPEDE.

The Velocipede movement, as it has been somewhat oddly termed, has made considerable progress during the past year. As might be expected, its origin has been claimed by the French and the Americans; but there is evidence to show that it was popular in England before it was ever heard of either in Franco or America. The *Builder* has taken some pains to set this matter right; first, by referring to an article in that journal, suggesting the application to velocipedes of india-rubber accumulators, in the year 1856. Again, in the *Builder* of October 4, 1862, a paragraph will be found titled "Velocipedal Progress," in which it is recorded that "Mr. Harris, landlord of the Fox and Crane, Bristol, had accompanied his brother in a journey by velocipede to London, on a visit to the International Exhibition." They went the 118 miles in twenty-one hours and a half, and returned comfortably in eighteen hours. During the same interval, too, hundreds of French and American, as well as thousands and tens of thousands of English, visitors to the Crystal Palace at Sydenham, must have seen the stud of velocipedes there, long before the new movement reached either France or America.

Even Ransome's "Rantoon," before the meaning of the term was understood, had assumed a shape as an improved velocipede before the French or the Americans had adopted the movement.

In 1862, it stated that the first American patent was taken out for an "automatic horse," or "cantering propeller," by which time also the movement had made progress in Paris. In August 1867, the *Builder* urged the improvement of the velocipede into a self-moving vehicle; and next year, as enabling persons to live out of town, in fresh air, by means of these vehicles, which are of little or no expense in comparison with a railway or omnibus.

"A postman has just been provided, by subscription, with one at Bangor, which greatly facilitates his labours along the country roads. Why does not some ingenious mechanic invent a *self-moving* vehicle of this sort, impelled by a powerful spring that could be wound up with a crank-handle, or by compressed air, india-rubber accumulators, or some such means, so as to save the perpetual movement of feet or hands? Some cheap form of self-moving miniature carriages, it is to be hoped, will ere long make its appearance.

"Now, does not this show that the movement in America was very specially connected, in its origin, with our idea of a *self-*

moving velocipede? We observe, too, from an article on 'Compressed Air for propelling Vehicles,' in the *Builder* of November 28, 1868, in which we refer to velocipedes, that compressed air, as we have shown that we had years before suggested, in connection with this movement, had then been successfully applied at New Orleans to street vehicles or cars. The air was compressed into light but very strong vessels, of a sort of paper mash, at a station, by means of steam power.

"The Americans have bicycles as well as the French; and the author of a History of the Velocipede, recently published, says the claim of the American patent of 1862 'embraces all the essential points of the modern bicycle.' Yet he somewhat inconsistently, as well as quite mistakenly, expresses his opinion that 'the resuscitation (of the velocipede movement) is due to the *petits crevés* and *cocottes* of Paris;' although he also says that the French bicycle was 'a thing of the future' '*as far back as* 1866.' In the *Scientific American* is recorded a patent for 'the two-wheel velocipede with treadles and guiding arms.' Thus, the bicycle and velocipede were known in America sooner than in France, as they were in England sooner than in America. And several years previously to 1866, *and even to* 1862, the movement had already been originated in England, and that the pioneer and originator of it was the *Builder*.

"We may conclude these notes by recording a few circumstances as to *recent* 'velocipedal progress.' Not only has the velocipede been adapted to locomotion on ice, but also on water; and a member of the Aeronautical Society, as reported in *Scientific Opinion*, suggests it as a basis for locomotion in the air!"

Paris, we are told, is all alive in this way. In the Bois de Boulogne, and on the suburban roads near the capital, such races are conducted under all sorts of conditions. As a skilful velocipedestrian can do his 12 or 14 miles an hour, and can continue this for four or five hours at a stretch, there is certainly a potentiality of contesting a rather formidable race. In one instance two Frenchmen challenged each other to do the greatest amount of distance in 24 hours; one accomplished 87 miles and then yielded, the other spun along until he had accomplished 123 miles. On another occasion a party of nine persons went from Rouen to Paris between an 8 o'clock breakfast and a 7 o'clock dinner, the distance being 85 miles. Very recently, in England (for the fit, be it observed, is coming upon us also), three velocipedestrians went from London to Brighton at the rate of 8 miles an hour—a part of the way at nearly double that rate. At Liverpool there is a velocipede race club, the members for which competed on a recent occasion for a silver cup; the winner accomplished eight miles in 44 minutes.

To these interesting records of the Velocipede we may add, that more than fifty years ago the father of the writer, with the aid of a clever artisan, constructed a velocipede, or "hobby-

horse," as it was popularly called, with three wheels; it was a costly experimental affair, and the builder being over 18 stone weight, his family were in a constant state of alarm at his enterprise—which ended in failure.

PENETRATION OF ARMOUR-PLATES WITH LONG SHELLS.

Mr. (now Sir Joseph) Whitworth, has read to the British Association "On the Penetration of Armour-Plates with Long Shells containing Large Bursting-Charges fired obliquely."

At the meeting of the British Association, 1868, he contributed a paper to the Mechanical Section "On the Proper Form of Projectiles for penetrating through Water." The paper was illustrated by diagrams, showing the effect produced on an iron plate, immersed in a tank of water, by projectiles with flat hemispherical and pointed heads. In that paper he claimed for the flat-pointed form of projectile, made of his metal, these points of superiority over the ogival-pointed projectiles adopted in the service: 1. Its power of penetrating armour-plates even when striking at extreme angles; 2. Its large internal capacity for bursting-charge when constructed as a shell; 3. Its capability of passing undeflected through water, and of penetrating iron armour below the water-line. The latter feature was, he thought, satisfactorily proved by the experiments described in 1868, and the author desired to draw the attention of the Section to the experiments made for illustrating the penetrative power of long projectiles with the flat front, fired at extreme angles against iron plates. These experiments were illustrated by the projectiles actually fired and the plates they penetrated, which were laid on the table, and also by diagrams.

WHITWORTH METAL.

Sir Joseph Whitworth, after a long course of experiment, has succeeded in producing iron and steel, which, as he states, will resist any amount of shock or strain that may be put upon them. This "Whitworth Metal," as it is called, is, while in a molten state, subjected to enormous pressure, by which all the air-bubbles—those sources of weakness— are got rid of, and the metal is rendered perfectly homogeneous. If Sir J. Whitworth be right in his conclusions, our iron trade is about to undergo another revolution. Besides guns of the largest size, which will send their bolt through anything and everything, and never burst, we shall have wheels for railway-carriages that will never crack, boilers that will never blow up, and wire for submarine cables that will not break in the laying.

An interesting account of the application of the Whitworth metal to ordnance, written by an officer of the Royal Artillery, has appeared in the *Times*. As this would occupy more space than we can devote to it, we quote its conclusion, which

clearly states the question: "Whitworth's system of artillery consists essentially in small-bore guns with long projectiles. The twist of the rifling must be rapid, because otherwise the long projectiles would turn over. All this involves a great strain upon the interior of the gun. Until now he has not succeeded in making heavy guns to stand this strain, except in small numbers at a prohibitory price. He now asserts that he has found the material he has so long sought; but there is as yet no heavy gun in existence made of this material. We say, let him make one and let it be tried. Then there is that other question of his shells, which has nothing to do with the gun question, and may be settled by firing some projectiles out of the costly pieces now in the possession of Government. If the shells succeed, it will be interesting to know whether Sir Joseph Whitworth can really make guns at a reasonable price capable of firing them. Then will come the last question, perhaps more difficult still to answer, where can such guns be placed without involving such a complication of ammunition and stores as would be detrimental to the public service? We hold that Sir Joseph Whitworth has made out a case for experiment."

GREAT GUNS AND GUN-COTTON.

AMONG the incidents with which M. Dumas was entertained during his recent visit to London for the Faraday Lecture, was a trip to Woolwich, where, under the guidance of Mr. Abel, he saw the making of big Guns in the Arsenal, and experiments with Gun-cotton which must have surprised him. A palisade was built of oak timbers a foot thick, firmly fixed in the ground, and supported in the rear by strong trusses. Discs of gun-cotton were placed along the face of the palisade about a foot above the ground, and were fired by a battery in the usual way. The effect may be described as wonderful. The palisade was literally blown away amidst a deafening report, as if the massive timbers offered no more resistance on one side of the gun-cotton than the atmosphere on the other. The discs require no fixing; merely laying them on is sufficient. Solid blocks of iron and stone can be shivered into fragments by firing a disc laid on the top. In future sieges, if some desperate fellow can but get to the gate or a thin part of the walls, and hang on a few discs of gun-cotton, a breach can be made by firing with a galvanic current from a long distance. Henceforth Indian stockades and New Zealand pahs will be but vain defences; and if a hole can be blown in the side of a ship, what will be the use of building vessels of war? After all, cotton may prove to be king in the shape of gun-cotton.—*Athenæum.*

A NEW STEAM STAMP-MILL.

A VERY efficient Stamp-mill has been introduced by the New York Steam-Engine Company, and those engineers who have adopted it express themselves thoroughly satisfied with its

operation. An excellent illustrated description of the machine has been published in a recent number of the *American Journal of Mining*, from which it appears that the stamps which are attached directly to steam piston rods are arranged in a group of four, and surrounded by a screen. The battery in which the stamps work is surrounded by a trough cast in the bedplate of the mill. The ore to be crushed is fed through a hopper directly into the centre of the group of stamps, and so distributed equally to all, and as fast as it is pulverised finely enough it is delivered on all sides through the screen into the trough. The stamping is done wet, and the very finest portion of the powder is washed over from the trough by the overflow of water through spouts into an outer surrounding gutter. There is a separate steam cylinder and piston for each stamp. The cylinders are all cast together with a surrounding exhaust steam jacket, and sole plate, and are supported on wrought-iron pillars erected upon the bedplate. All the cylinders can be adjusted simultaneously by means of nuts fitted to screw threads on pillars, for the purpose of adjusting the clearance between the piston and the top and bottom of the cylinder, and for maintaining a uniform clearance by lowering the cylinders as the stamps wear away and allow the pistons to descend lower. The steam acts above and below the pistons, so that it not only lifts the stamps, but the force of its downward pressure on the piston is added to that due to the weight and fall of the stamps. Each cylinder has an independent valve and automatic valve gear, so that each piston and stamp may work independently of all the others. The valves are short double-faced slides, working horizontally in the chests, and operated partly by the steam and partly by conical surfaces on the upper parts of the piston and stamp rods, which pass upward beyond the tops of the steam cylinders into closed central caps on the cylinder covers. The conical parts of the rod act upon the valves through levers and attached slides. This method of operating the valves permits the stamps and pistons to turn freely as required. The cylinders are 5½ in. diameter, and the pistons have from 6 in. to 8 in. stroke, according to the depth of material in the battery. The machine is estimated at about 30-horse power, and is stated to crush thirty tons of hard ore in twenty-four hours.—*Mechanics' Magazine*.

INDIAN INK.

THE manufacture of Chinese Ink, to give it its proper term, is carried on upon a very large scale at Shanghai, where a very superior description is prepared. The cause of the difference in quality between the various inks made in China results from the non-employment of a constant material for the production of the lamp-black. In order to impart an agreeable odour to the production, the Chinese add a small portion of musk and camphor, from the Isle of Borneo, two articles which are exceedingly dear in the celestial empire. Ordinary Chinese ink for home use is

not scented in any manner whatever. The gilded mystic letters that are so attractive to young pupils and students are first formed by the action of the mould. When the cake is dry, the letters are traced over with a solution of gelatine in water, and the gold or copper is laid on with a fine brush. Like their neighbours the Japanese manufacture Indian ink, but consider it of a quality inferior to that which they obtain from the mainland. Not having given so much attention to the matter as the Celestials, they are not so well versed in the manner of preparing the lamp-black, which is the real secret of the whole art.—*Mechanics' Magazine.*

CRAMPTON'S COAL-DUST FIRE.

SOME time ago Mr. Crampton conceived the idea of utilising Coal Waste by grinding it to a fine powder and burning it by a blast jet suspended, as it were, in the air, much as one has seen lycopodium seed blown through a spirit lamp into a cloud of flame. By practical experiments it was soon seen that a large economy in the consumption of fuel, as well as a more uniform condition of heating in the furnace, was possible by this mode of combustion, and that ultimately it might be advantageous to employ fuel in this way instead of in the customary manner. Permission was recently granted Mr. Crampton, on the recommendation of General Balfour, for a trial of the process in one of the furnaces of the gun factory at the Woolwich Arsenal, and a practical exhibition was made in the presence of the War Office, Control, and Arsenal authorities, and many influential ironmasters and manufacturers. The trial was made in an ordinary heating furnace, fitted up in a temporary but sufficiently effective way for the immediate purpose of this experiment. The fuel operated with was the fine siftings of the Bebbside coal, and in the Arsenal works ground in an ordinary mill ("Peak" stones of 3 ft. 6 in. diameter) to a fine powder. This powder is put into a hopper, from the base of which it falls down a shoot or feeder, and meeting at the bottom with the strong draft of a horizontal blast pipe, there is blown forward a rolling cloud of mixed air and coal-dust, the current shooting downwards obliquely into the combustion chamber, the lighter dust firing instantly, and the heavier having time given it to consume before entering the utilising chamber, where piles of iron scrap were placed for heating. The work was carried on by the regular workmen of the factory by the "piece," the same as at the other furnaces; the piles coming out in about the same time as from the rest, but exhibiting a very fine heat indeed without any symptom of "cutting." Indeed the results obtained were satisfactory in the highest degree. The total of work carried on with this furnace on the day previous in one shift was 5 tons 4 cwt. 3 qrs. 13 lbs. by the consumption of 36 cwt. of coal-dust.—*Standard.*

Natural Philosophy.

THE FARADAY LECTURE.

THE first Faraday Lecture, delivered before the Chemical Society, at the Royal Institution, presented several remarkable features. The Council chose for this purpose a Frenchman, M. Dumas, the great chemist, who gave up his time to this duty, and whose address to a large English audience was given in his native tongue. Dr. Williamson, the President, thought it was a fitting commemoration of Faraday, that a most intimate friend and associate in the great world of science should represent the catholicity of his discoveries. It was in this spirit M. Dumas accepted it; and from that place, so often occupied by Dr. Thomas Young, Davy and Faraday, Dumas proceeded to deliver his discourse. What the nature of it was to be no one knew, nor from the beginning could any tell whether it was to be a formal *éloge* or how it was to shape itself. After a few remarks on the nature of the individual discoveries of Faraday, he proceeded to observe that these discoveries connected themselves with four great topics, the nature of inorganic matter, and the nature of the forces by which it is operated upon; the nature of organic matter, and the nature of the forces operating on this matter. These were problems which had occupied the ancient world, and particularly the great Greek philosophers; and he maintained that in substance our real and ultimate knowledge was in the same state as that of the Greeks, and went no further. In rendering a tribute to Aristotle and his fellows, he affirmed that Faraday had approached all those subjects in the spirit of a Greek philosopher. He described what Faraday, and more particularly Dalton and other Englishmen, had done to show the identity of matter; and he avoided all reference to foreign philosophers, except, as it were on compulsion, to Lavoisier. He went on to detail the means by which Faraday had proved the identity of forces, and their relation to that of gravitation; but he affirmed that of this ultimate force we know no more than Aristotle did, and that the knowledge of it rested with One above. By this time it was perceived that the oration of M. Dumas, delivered with the ease and grace almost of an improvisation, and assuredly with the gifts of a refined orator, was a vindication of natural science in the sense of immaterialism and in the spirit of Faraday. Proceeding to organic matter, he described the way in which modern chemistry had succeeded in multiplying the combination of its forms, and in imitating with inorganic elements organic substances. He referred to the influence of solar heat and light in the development of the organic world, and to the dispersion of the constituents of these into that infinite space, the elements of which we know to be the same as those of this globe.

He denied, however, that the chemist with all his endeavours had ever imitated life itself, or would ever be able to produce a living being. There must be a living seed for a living plant, and a living egg to produce a living animal. These, he said, were something beyond, far above human power, and within the power of God alone. That was the spirit, the orator affirmed, in which these great subjects had been regarded by Faraday, and he believed it was in that spirit the audience there assembled had met to commemorate Faraday. They did not believe that all of Faraday lay beneath the cold gravestone. He was there among them, sharing in their thoughts, for if he had not believed in the immortality of mind above matter he would never have laboured for the benefit of science and the advancement of the human race.

M. Dumas ended with applause. He was listened to throughout with attention by a crowded audience; applause alone had interrupted him, and that sometimes with untimely zeal. He had aroused the enthusiasm he felt; and with the unanimous thanks of all, touchingly proposed by Prof. Tyndall, the spectacle of the defence of immaterialism by a *savant* of France before an English audience, was closed. In returning thanks for the attention shown him, M. Dumas expressed his hope that the example of that day would be imitated elsewhere. He wished to hear his English brethren in Paris, and at all events the Centenary of Lavoisier in 1872 would afford a fitting opportunity. He also applauded the idea of the Chemical Society in devoting this celebration to Faraday; for, he said, Academies had too often bestowed their attentions on princes and statesmen, but in this instance with far greater propriety, for Michael Faraday was a prince in intellect and a power in the realms of science.—*Athenæum.*

ARC OF THE MERIDIAN IN THE CAPE OF GOOD HOPE.

ONE of the Royal Society's Medals has been given to Sir Thomas Maclear, Astronomer Royal at the Cape of Good Hope, for his measurement of an Arc of the Meridian in that colony. This may seem but a small matter to be thus honourably recognised; but to those who know what such a measurement involves—that important questions in astronomy are therewith connected, and that it is essential to accurate knowledge of the figure of the earth, the award of the medal will be appreciated as it deserves. The circumstances of the case, moreover, are such as command recognition. La Caille measured an arc of the meridian at the Cape of Good Hope in the middle of last century; but astronomers have not been able to accept his results with confidence, owing to the magnitude of the degree inferred from the measurement being too great, which (if true) would lead to the conclusion that the dimensions of the Southern Hemisphere were not the same as those of the Northern. The question was in this unsatisfactory state when the late Colonel Everest, returning

from India on sick leave in 1820, tarried at the Cape, went over La Caille's ground, and pointed out the discrepancies between his results and those obtained in similar operations in the Northern Hemisphere. The next step in connection with the question was taken by Sir Thomas (then Mr.) Maclear, shortly after his appointment to the Observatory at the Cape. Encouraged by the advice of Sir John Herschel, who was then in the colony, he with much labour recovered La Caille's terminal stations, and commenced the re-measurement in 1836. The difficulties of carrying on such a work in a wild country are great; but they were overcome, and the triangulation was extended beyond La Caille's northern station, across a vast sandy plain to a spot free from any visible source of local attraction. By this and a similar extension to the south, Maclear's arc has an amplitude nearly four times as great as that of La Caille; but the degree derived from it is 1,133 feet shorter, and is regarded by the best authorities as a "near approximation to the truth." La Caille had, as may be supposed, been misled by the local attraction at his northern station. A full account, in two quarto volumes, of Sir T. Maclear's operations was published by the Admiralty in 1866: it describes the instruments and methods employed, and with respect to these, as was stated by the President, "this arc of the meridian may be regarded as inferior to none on record."

LOCAL ATTRACTION.

COLONEL SIR HENRY JAMES, Director-General of the Ordnance Survey, reports that during the past year inquiry has been prosecuted into this very remarkable phenomenon. He observes that the relative extent to which the plumb line and the levels of our astronomical instruments are affected in a country where there is nothing on the surface of the ground to account for it, may be judged from the fact that it is nearly double the amount of the deflection on Schehallion mountain, 3,547 ft. high, with the instrument placed on the sides of the mountain itself, at one-third of its altitude, the position to produce the greatest effect from the mass of the mountain on the plumb lines. He considers that we have very decided indications that the cause is in the granitic rocks which extend in a south-west direction from Cowhythe through Banffshire, and which are highly impregnated in some parts with magnetic iron in a metallic state. The range of mountains on the south-east of Banffshire culminates in Ben Muich Dhui, 4,295 ft. high, which, after Ben Nevis, 4,406 ft. high, is the highest mountain in Scotland. The great amount of the attraction at Cowhythe, and along the coast to the east and west of Portsoy, cannot be explained by anything visible on the surface, and obliges us to imagine the existence of some large and very dense mass of matter underneath it. Sir H. James hopes to resume this important inquiry this season; and the geological structure, as well as the mineral character, of the

rocks will be carefully investigated by the Director of the Geological Survey of Scotland.—*Mechanics' Magazine.*

THE GREAT MELBOURNE TELESCOPE.

INTELLIGENCE has been received at the Royal Society of the arrival in Melbourne of the magnificent reflector which is henceforth to be known as the Great Melbourne Telescope. Mr. Ellery, the Government Astronomer in Victoria, reports that a rectangular building, eighty feet by forty, with travelling roof, was in course of erection to lodge the instrument; and as it was to be finished in two months, we may believe that the telescope has been tried, and that the Colonial Legislature have not repented of their vote of £5,000 to pay for it. That their liberality has not abated is manifest by their granting a further sum of £1,700 to pay for the building. The piers which are to support the ponderous tube are constructed of grey basalt, known locally as "blue-stone," in blocks of from one to three tons weight; and it is satisfactory to know that the several parts of the telescope and the specula were all landed in good condition. Mr. Le Sueur, the astronomer selected to work the telescope, was on the spot to receive it.

Sir Edward Sabine, in his Presidential Address to the Royal Society, states that the Telescope is now at the antipodes, and at work, but not with the same satisfactory results as when it was tested by Messrs. Grubb, in Dublin. This, as Sir E. Sabine explains, may arise partly from an imperfect knowledge of the principles of construction, and inexperience in the use of so large a telescope; partly from experimental alterations made at Melbourne, and partly from atmospherical circumstances: still, all the original conditions may be restored. Meanwhile, the instrument has confirmed the high impression formed of its powers by the Committee of the Royal Society, under whose superintendence it was constructed. During two nights in June last it was directed towards the great η Argûs, and remarkable changes were discovered to have taken place therein since it was described in 1834 by Sir John Herschel. The peculiar opening, which that eminent astronomer compared to a lemniscate, is still very sharply marked, but its shape and magnitude have altered. Its northern extremity is opened out into a sort of estuary; one of the remarkable constructions then seen has disappeared, and the other has shifted its place, and two stars which were exactly on the edges of the opening are now at some distance within the bright nebulosity, as was well shown in two drawings of these phenomena, exhibited in the meeting-room. Other changes are mentioned which we need not particularise here further than that their angular magnitude is such as to "suggest a strong probability that this nebula is *much nearer* to us than the stars which are seen along with it." This is a good beginning for the great telescope, and we may expect to hear of further achievements,

for the photographic and spectroscopic apparatus constructed for use in connection therewith have been safely received at Melbourne.

Though failing in its immediate object, the action of the British Association in this matter has not remained fruitless. The telescope is now erected at Melbourne, and in the hands of Mr. Le Sueur, who has been appointed to use it. It is a reflector of 4 ft. aperture, of the Cassegrain construction, equatorially mounted, and provided with a clock-movement. We may expect before long to get a first instalment of the results obtained by a scrutiny of the southern heavens with an instrument far more powerful than any that has hitherto been applied to them—results which will at the same time add to our existing knowledge and redound to the honour of the colony, by whose liberality this long-cherished object has at last been effected. The Reflector is engraved and fully described in the *Year-book of Facts*, 1869.

THE SUN'S "GLORY."

The conclusions of the American astronomers as to the nature of the brilliant protuberances and the aureole which surround the Sun on the occasions when it is eclipsed are not allowed to pass unquestioned by French *savants*. At the last meeting of the Académie des Sciences, M. Faye called the attention of the members to the results of the observations made on the occasion of the last eclipse. He said that M. l'Abbé Moigne had placed the photographs of the sun taken by the American mission at his disposal. After remarking on the peculiar appearances presented by the protuberances, one of which he likened to the masses of vapour that are sometimes seen floating over water, another to a whale with an enormous tail, he said of the latter: —"This protuberance was 70,000 miles in length; its total volume, making all allowances, would be 50,880,000,000 cubical miles." As those protuberances could now be examined at leisure, the chief interest was centred in the golden ring which surrounds the black disc of the moon during an eclipse. Professor Young's conjecture that the brilliant rays which constitute this ring are a permanent aurora borealis, the result of incessant electrical discharges similar to those seen in the Arctic regions, is disputed by M. Faye, who thinks the conclusion is not warranted by what is known of the constitution of the sun. As for Mr. Pickering's statement, that the solar crown gave no trace of polarisation, the same learned *savant*, who has made the sun his peculiar study for many years past, conceives that Mr. Pickering is mistaken in his opinion on this matter; and he brings in support of the opposite supposition (for it is difficult to call it by any other name when the contradiction between scientific observers is so absolute) the observations made by M. Mauvais in 1852, and by M. Prozmowski in 1860. It is asserted, apparently for the purpose of explaining how Mr. Pickering fell into

the error imputed to him, if error it be, that he used an instrument for making his observation which destroyed the polarisation. Seemingly with the view of appeasing any pain that the discussion might cause to the susceptibilities of the American observers, they are congratulated on having enriched science with photographs of fleeting phenomena most valuable for present study and future comparison.

SOLAR RESEARCHES.

M. Janssen has communicated to the French Academy from Simla, in India, the discovery of a hydrogen atmosphere around the sun, and also the existence of a connection between the solar spots and the solar protuberances. He considers the hydrogen atmosphere to be one of the two elements of the future sea.

Professor W. A. Miller has announced the interesting discovery of a means by which the red prominences which form so remarkable a feature of solar eclipses may be seen at any time. The method consists of intercepting by means of coloured glasses all the components of solar light except those of which the prominences are composed. The chromosphere, as the surrounding stratum of hydrogen discovered by Mr. Norman Lockyer is called, being of the same composition, will also be thus visible. This discovery will enable astronomers easily to observe the disturbances in the prominences, and their connection with the spots and other solar phenomena.

THE SUN AND THE FIXED STARS.

Professor Grant, in his concluding lecture on Stellar Astronomy, at the Royal Institution, has given a recapitulation of the facts connecting the Sun with the Fixed Stars which have been established by the observation and researches of astronomers. 1. The stars, unlike the planets, are apparently independent of the sun. 2. The stars are variable in brightness: Father Secchi has found, on comparison, that the spectrum of the interior of the sun's spots resembles that of red stars which contain many dark bands (such as Antares and Aldebaran), and therefore concludes that they owe their colour to the same cause which produces the spots in the sun. All these are variable, and their variability depends upon the spots. 3. The intrinsic splendour and magnitude of some of the stars have been proved by the combination of parallax with the results of photometric experiments to greatly exceed those of the sun (Alpha Lyræ by twenty times). 4. The observation and study of the double stars has proved that the law of gravitation prevails among them; and Struve considers that a very large number of the stars are physically double. 5. Copernicus considered the sun and stars to be stationary in the heavens; Halley, however, discovered the

proper motion of the stars in space; and now the sun has been proved to be moving at the rate of 17,400 miles an hour. 6. The constituent materials of the sun and the stars have been shown to be analogous by the revelations of the spectroscope. The stars, then, are distant suns, most probably the centres of planetary systems resembling our own.

SOLAR ECLIPSE.

The *Alta California*, on August 27, reports the full success of the most distant observing expedition on the American continent, —that of Prof. Davidson, of the United States Coast Survey, in Alaska, to observe the Total Solar Eclipse on the 7th of that month. All the usual phenomena of red flames, &c., at totalities, were seen and measured. At the astronomical station, and on the steamer accompanying another party, the Indians were fearfully alarmed, and hid in their houses. On the river they left their canoes and took to the bushes: they had expressed their disbelief in the prediction, but the actuality made them look upon the astronomers with undefinable awe. Prof. Davidson, in addition to the special eclipse observations, has determined the geographical positions of numerous points in the line of exploration, and has discovered a mountain-range of magnetic iron ore, 2,000 feet high, extending from the mouth of the Chilkahe far beyond his astronomical station.

SELENOGRAPHY.

Mr. W. R. Birt, in introducing to the British Association the Report of the Lunar Committee, referred to the progress of Selenographical research since the Committee was appointed at Bath, in the year 1864. A surface of 100 square degrees, *i.e.* 10° of S. latitude, and 10° of W. longitude, has been surveyed during the period; the outlines of 433 objects laid down on a scale of 200 inches to the moon's diameter; and a catalogue prepared, which contains notices of phenomena bearing on questions which have been mooted relative to the physical aspect of the moon's surface. The great question of continued lunar change, either transient or permanent, as contrasted with apparent change, dependent upon illuminating and visual angle, is one most likely for posterity to settle. If, in geological science, a region undergoing a series of changes—during the progress of which, through a long period of geological time, lakes have been drained, volcanoes have burst forth, extensive plateaus of igneous ejections formed, and vast denudations of softer materials effected, —has retained its grander and more imposing features in their integrity,—so in selenological science we may rather look for small, and, in many cases, to us almost inappreciable, changes in and around well-recognised and imposing lunar forms, than expect to witness the obliteration of some very striking object as

as evidence of change. The report treated somewhat largely on the general question of changes on the moon's surface; and several instances were adduced as proofs that the surface of our satellite had undergone successive changes during its past history. The determination of successive extraordinary changes which were named were said to rest on the strong indications afforded by the careful study of photograms, of the priority and posteriority of well-marked features, which can only be realised by contemplating the lunar picture in the seclusion of the study. While the telescopic view is far superior to the photographic, the continual changes of illumination and visual angle prevent that appreciation of the relations of different features to certain epochs of production which can be so well studied in the photogram. The detail thus seized upon by the aid of photography is vividly realised by the eye at the telescope, when the surface of the moon is suitably illuminated.

HEAT FROM THE MOON.

At a recent meeting of the Academy of Sciences, Paris, M. Marié-Davy announced, as the result of careful experiments, that lunar radiation is incapable of raising the temperature of an air-thermometer, coated with lamp-black, even a millionth of a degree. This is equivalent to saying that there is *no* heat radiated from the moon, which is a result directly at variance with that communicated last session to the Royal Society by the Earl of Rosse. After a series of careful experiments made with his three-feet reflector, his Lordship was satisfied that heat is radiated from the moon, and that "it is capable of being detected with certainty by the thermopile."—*Athenæum.*

HEAT OF THE STARS.

In the summer of 1866 it occurred to Mr. W. Hughes, that the Heat received on the Earth from the Stars might, possibly, be more easily detected than the solar heat reflected from the moon. Towards the close of that year, and during the early part of 1867, he made observations with thermopiles, and a very sensitive galvanometer, prepared for him by Mr. Elliott, and succeeded in obtaining trustworthy indications of stellar heat in the cases of Sirius, Pollux, and Regulus.—*Proc. Brit. Association.*

SPOTS AND SHADOWS IN THE LUNAR CRATER "PLATO," BY MR. W. BIRT.

Certain peaks on the western wall of the crater have been measured by Beer and Mädler, the heights varying from 5,000 to 7,000 English feet. These peaks at sunrise cast well-defined long shadows on the floor, and these shadows had been measured by Prof. Challis, of Cambridge. The fact of the shadows having

been measured left no doubt of the existence of certain irregularities in the shadow corresponding to the irregularities on the summit of the wall. From drawings of Plato, delineations of the shadows by Prof. Challis, the late Lord Rosse, the late Rev. W. R. Dawes, and J. Birmingham, Esq., of Millbrook, have been compared. Amongst the interesting results the proximity of the shadows of the three principal peaks to three very minute craters on the floor of slate may be named, thus furnishing the means of readily identifying these craters at any future time. In the concluding part of the paper Mr. Birt urged the importance of multiplying such drawings, as a discussion of them in reference to the moon's year may make us better acquainted with the wall itself.

SUPPOSED ACTION OF LIGHT ON COMBUSTION.

PROFESSOR C. TOMLINSON remarks: The popular idea that "light puts out the fire" is so fixed that probably no conclusions drawn from actual experiment are likely to disturb it, especially if they be adverse to the notion. From a series of experiments upon candles of different sizes and weights in dark chambers and day and sun-light, it was found that the increase of temperature led to increase of consumption of material and *vice versâ*, and the whole result may be stated, that in any case the difference is so small that it may be referred to accidental circumstances, such as temperature and material: the final conclusion being that the direct light of the sun, or the diffused light of day, has no action on the rate of burning, or in retarding the combustion of an ordinary candle.

UNDERGROUND TEMPERATURE.

MR. G. J. SYMONS has read to the British Association the Report of the Committee on Underground Temperature, drawn up by Professor Everitt, relating their observations in a well at Kentish Town 1,000 ft. deep. They had found the truth at the bottom of this well, that the temperature increases at the rate of 1 deg. for every 52·4 ft. increase of depth. A thermometer contrived by Professor Sir W. Thomson, very strong but sensitive, will be lent by the committee to persons undertaking to make such observations.

An interesting paper on The Nature of the Interior of the Earth has been contributed to the *Popular Science Review* by Mr. Forbes. In this paper it is stated that formerly the earth was supposed to consist of a molten mass encircled by a solid crust about forty miles thick. But, inasmuch as the pressure at the centre of the earth was necessarily very great, and as it had been shown by Professor James Thomson and others that the melting point of solids became high in proportion as the pressure ascended, it had since been inferred that the interior of the earth

must be solid, as it was believed that the solidifying influence of the pressure would balance the liquefying influence of the heat. This inference, however, Mr. Forbes considers to be gratuitous, as it is not certain that above the position of maximum density the melting point rises, and it may even fall. Hence he concludes that the old hypothesis of the fluidity of the interior of the earth has the largest claims to acceptation.—*Illustrated London News.*

SELF-REGISTERING HYGROMETER.

Mr. E. Vivian of Torquay has read to the British Association a paper on his new Self-registering Hygrometer. At a former meeting, he exhibited a self-registering instrument on the cumulative principle of recording mean values of the differences between wet and dry bulb thermometers, and a self-registering maximum and minimum hygrometer. He now produced an improved form of the former instrument, with a series of curves showing the comparative results of Leslie's hygrometer, his maximum and minimum differential, and his mean self-registering, which he now offered as the standard. He gave the uses to which it might be put. He had used it in recording the aggregate differences of solar heat of the sun and shade, the duration of rain, and the amount of nocturnal radiations, and many other similar purposes. He now proposed to apply it to recording the actual mean temperature, which would be an important feature if it could be worked out, and he believed it could, and also to the anemometer. He gave a full description of the instrument and its mode of working.

Mr. Symons thought the instrument valuable, and said he should like to see such a one at every watering-place. He referred to the differences in the meteorological instruments used, and their position in different parts of the country, and said he should like to see every town furnished with a good set of instruments, placed in suitable and open positions.

NEW SELF-RECORDING ANEROID BAROMETER, BY MR. MARTIN.

The purpose of this instrument is the production of a permanent record of those important fluctuations of atmospheric pressure which, occurring between the stated hours of observation, either pass entirely unnoticed or remain unregistered. The necessity for such an instrument has been suggested by the consideration that the simple mercurial or aneroid barometer does not afford on inspection all the information such an instrument might be made to yield. The height of any given moment of observation is of course always ascertainable; and, provided the index has not been moved in the interval, it will show where the mercury stood at the time of the last observation, but it does not show the rate at which the barometer is falling, nor the time the last change took place—both facts being most important aids in

enabling the observer to make a good weather forecast. The hourly self-recording aneroid barometer supplies this information. The makers think the instrument would moreover prove available where the more elaborate system of photographic records could not be adopted, and they venture to say that if a number of these instruments were distributed at suitable stations in different parts of the world, they could not fail to furnish a mass of information of the greatest possible value could the whole of the diagrams be brought under inspection at the end of the year in one place.

PHOSPHORESCENCE OF THE SEA.

Mr. Allnutt, in a communication to the *Times*, from Eastbourne, writes:—From the 4th to the 12th inclusive the mean temperature was daily above the average of July. Yesterday (12th) was sultry and cloudless, and the sun shone with great power. At 4 p.m. a thermometer in his rays registered 112°, and the shade heat was 72°. On the whole day the mean was 67°, which is 5·1° above the computed average.

In the evening the sea was beautifully tranquil, and so light was the air that the track of steamers in the offing could be discerned for long distances. A low wall of cloud lay out at sea, forming a rigid horizontal line far down in the south.

At 10 p.m. the air was calm, the tide flowed in with gentle motion, and the crest of the surf as it broke upon the shingle became vividly luminous, the phosphorescence being in some instances as bright as the nucleus of an ordinary aërial meteor.

A gentleman residing here, who takes much interest in the pursuits of natural science, tells me that on this coast the occurrence may be regarded as quite a *lusus naturæ*.

If the *noctiluca miliaris*—the animalcule by which this phosphorescence is supposed to be produced—is always to be found in these coast waters, how is it that its presence is so seldom manifested?

Let us look at the elemental physical conditions under which it became visible.

Yesterday had been a brilliant day, atmospheric electricity was abundant, the wind had shifted from east to south-west, and electric clouds (cirro-cumuli) were gradually overspreading the sky. An old boatman on the beach told me the sea never "burnt" except the wind had been blowing from the east. May it not be that a certain combination of positive and negative electricity is necessary to elicit in a calm sea the vital action for luminosity of these minute infusorial rotifers?

FOREST CONFLAGRATIONS.

There are three principal causes to which may be attributed the Ignition of Forests. They are wilful incendiarism, accidental incendiarism, and spontaneous combustion. Many persons are

sceptical on the subject of the last-mentioned cause, but there is abundance of the most reliable evidence to prove that it has been productive of destruction not only to vegetable but also to animal life. In investigating the liability of forests to these several chances of conflagration, the first may be omitted, as it is scarcely possible to prevent an evil-disposed person setting fire to a wood if he be so inclined. The other two causes may be guarded against, as they depend upon a variety of existing contingencies, which are well known and recognised as imparting an inflammable tendency to the standing timber. As may be anticipated, the nature of the trees, the character of the soil, and the geographical locality exercise considerable influence upon the chances of combustion. That the mineralogical constitution of the soil plays an important part, in these instances becomes evident as soon as attention is directed towards forests, some of which spring from a calcareous and others from a granitic substratum. The oak, the pine, and the arbutus, which together are frequently met with growing upon the former description of geological formation, are thus comparatively secure from ignition. There is very little, if any, accumulation of brushwood, and moreover it is not of a very inflammable nature, so that even when a fire does occur it rarely commits any very serious or extensive devastation. The case is widely different when the character of the soil is granitic, and is, in fact, composed of the disintegrated particles of primitive rocks. This imparts an especial resinous property to the vegetable productions, and also largely increases the quantity of brushwood, particularly of the heather, which is the most dangerous specimen of the class. It is in this mass of dry wood and *débris* that lurk the seeds of future conflagrations, and which feed them until they acquire sufficient fierceness to seize upon the larger trees, and extend their ravages sometimes over a whole district. During the hot season this inflammable mass becomes desiccated to so extreme a degree as to be ignited by the merest spark, and the rapidity with which the flames spread seldom leaves much chance of extinguishing them. As a rule, the fire is extinguished by consuming itself. It dies out.—*Mechanics' Magazine.*

PHOSPHORESCENCE.

Dr. Moffatt has read to the British Association a paper—"On the Phosphorescence of the Sea and Ozone in Connection with Atmospheric Conditions." It appears from observations taken at sea, that, as on land, ozone periods commence and that ozone is in maximum quantity with decreasing readings of the barometer and the conditions of the south or equatorial current of the atmosphere; and that ozone periods terminate with increasing readings of the barometer and the setting in of the polar current. Periods of luminosity of phosphorus and ozone periods take place with the conditions of the equatorial current,

and that non-luminosity and non-ozone periods occur with the polar current; and by tabular results he showed that the luminosity of phosphorus and the phosphorescence of the sea take place under the same atmospheric conditions, and that there is an intimate connection between ozone periods and periods of ocean phosphorescence.

PERCEPTIONS OF THE LOWEST ANIMALS.

The following interesting fact may be of no practical importance further than showing that the Perceptions of the Lowest Animals seem to accord with our own. When a basin of water containing some of those active little animals, water-fleas, is surrounded with blackened paper the animals sink into inactivity; but when a strong beam of light is sent through a hole in the paper, they spring at once into activity and collect in the illuminated part of the water. Further than this, if a spectrum be projected through a slit in the paper, the greater number of animals collect in that part of the water illuminated by the orange yellow rays, and the fewest in the line of the violet, which would seem to indicate that they too most readily perceive yellow light.—*Mechanics' Magazine.*

NATURAL GAS.

What the interior of this globe of ours holds, whether it is a solid, a void or vacuum, or a seething mass of molten rocks, a globe of liquid fire, we do not really know. The phenomena of earthquakes, volcanoes, boiling springs, &c.; the increasing heat as the earth is penetrated; the fact that the temperature is greater at the surface of the earth, or the sea level, than above it, and the escape of inflammable gas from artesian wells, seems to point to an internal inferno of iron. Centuries ago these phenomena were noticed, and their existence used as an evidence of a hell, the locality of which was the centre of the earth. Still, no one of these, nor all taken together, is absolute proof of an incandescent interior. We have never yet penetrated the crust of the globe, nor even probed the crater of a volcano and reached the great internal cavity. If the crust is, as has been estimated, about thirty miles thick, the amount of force necessary to raise the tons of liquid lava to the orifice of a mountain is simply inconceivable, and its effect on the surrounding walls and the surface would be sufficient to materially change the physical characteristics of the country for hundreds of miles around. So, if the earthquake receives its impetus of motion and its almost incalculable power from the agitation of an internal sea of liquid igneous matter, confined within a crust of thirty miles in thickness, and the throes of this sea are transmitted and communicated through this mass to the surface, would the most disastrous earthquake known to history or tradition be sufficient to account for the exercise of such a power? The force that could

move, or break, or shake the crust of the globe would be sufficient to turn our continents into bottomless seas and our oceans into mountainous deserts. At most, we have a shaking of the surface, a superficial disturbance of the ocean; but no disappearance of the sea through some cavity reaching the molten centre of the globe, and no vomiting forth of a consequent mass of steam, vapour, and lava sufficient to destroy all animal life, and to make the earth a desert.

Volcanoes and earthquakes may be accounted for without descending to so great a depth. If the earth's crust is thirty miles thick, there is ample room for the reservoirs of all the power-generating materials necessary for the production of eruptions and earthquakes. That this crust is not solid or homogeneous is not only proved by theories based on analogous truths, but is actually demonstrated by mining, well boring, and the existence of immense caverns, with plains and hills, and lakes—a subterranean landscape. The increasing heat of the earth below the surface no more demands a vast internal furnace for its existence than does the superior temperature at the earth's surface over the inferior temperature of the cloud line or the mountain tops. Both may be assigned to the same, or a similar cause, that of weight or pressure, or both combined. What other occult or unknown causes, as electricity, magnetism, galvanic agencies, the nature of which we do not understand, it is immaterial now to enquire. Suffice it to say, that we know that the earth's crust (to use a familiar term without assenting to the theory of the believers in the igneous philosophy) is not solid, and that it contains explosive and inflammable gases which may be sufficient in quantity and powerful enough in explosive and dangerous quality to produce all the phenomena of volcanic eruptions and earth shakings. The difficulty of accounting for the extended character of these latter phenomena—earthquakes—is no greater than if the theory of an internal globe of liquid fire be accepted, as is evident by the statements made by the supporters of that theory of the thickness of the earth's crust.

That the earth (not merely its interior, but the crust of the globe) is a gasholder, it would be nonsensical to deny. All our coal, whether bituminous or anthracite, contains inflammable gases; coal mines are infested with it, and many of the delvers in their depths annually lose their lives by its explosion, either from accidental causes or spontaneous ignition. No one who is at all acquainted with the business of boring for oil will deny that emissions of inflammable gas are a necessary concomitant to well boring. In the oil regions this gas is frequently and extensively used as fuel for driving the engines, or rather for generating steam. A notable instance is one we mentioned twenty-one months ago, where we spoke of a large manufactory in Erie, the machinery of which was driven and the buildings lighted by the gas from an unproductive oil well. The establishment is that of H. Jarecki and Co., brass workers. For more than two

years they have led gas by means of a 3-inch iron pipe from an unsuccessful oil well 1,200 ft. distant from the manufactory, and used it as fuel for their boilers and as light for their works. The flow is never stopped, never changed in amount of pressure; the gas is of good lighting properties, and when at night or on Sundays the works are stopped, the gas still comes; at night being lighted at the mouth of a pipe of 2 in. or 2½ in. diameter, situated near the top of the main building. This light is sufficient to illuminate several streets and squares in every direction, and the escaping gas makes a noise as of escaping steam, that may be heard at a long distance, while the gas flame is not less than 4 ft. or 5 ft. high.—*Scientific American.*

PROPERTIES OF METALS.

A Royal Society Medal has been awarded to Dr. Matthiessen, Lecturer on Chemistry, at St. Bartholomew's Medical College, whose reputation as an accurate and trustworthy experimentalist is well established. His researches into the electrical and other physical Properties of Metals and their alloys have been followed by important advantages to commerce as well as to science. What the scientific results are may be seen in the *Philosophical Transactions*, and the Royal Society's *Proceedings*. As regards practical applications, telegraph engineers now constantly avail themselves of the laws deduced from the results of Dr. Matthiessen's electrical experiments; to his investigations is due the improvement in the conducting power of the copper wire now used in submarine telegraph cables; and to his production of an alloy of platinum and tin electricians owe the resistance coils now given out by the Electrical Standard Committee of the British Association, and adopted as standard instruments. With characteristic perseverance he has investigated the chemical constitution of cast-iron, and has at length discovered a way of producing chemically pure iron, which cannot fail of important results. Other researches by Dr. Matthiessen are—on the action of oxidizing agents upon organic bases, and the chemical constitution of narcotics, on which he has already arrived at conclusions full of promise of future success.

EFFECT OF COLD ON METALS.

The effect of extreme Cold on Metals, and particularly on iron, has often been remarked in this country. The axles and springs of railway carriages are known to be much more liable to fracture during a severe winter than at other times. Other metals, too, are more or less affected by cold. The leaden pipes which burst with the frost would no doubt bear a much greater strain at a higher temperature, when the metal would simply expand with the pressure. On tin, however, the effect of great cold is

much more marked. Some pigs of Banca tin exposed last winter at St. Petersburgh underwent a most remarkable change. The metal became fibrous, and deep fissures were produced in various directions. Fritsche, who details the circumstances, mentions that the phenomenon had been observed before in Russia, once in the case of the pipes of a church organ which were cracked and rendered useless by the frost, a fact which shows that organs built for cold countries should be well cased. In the instance of mercury, it was stated by M. Dumas, that the frozen metal, when brought to a much lower temperature than its freezing point, undergoes a remarkable change in its molecular state. Cold means condensation, and no doubt produces some change in the form and arrangement of the ultimate particles of the metal whereby its physical properties are considerably modified.—*Mechanics' Magazine.*

IRON—HEAT AND STRAIN.

Mr. Gore has noticed a new fact in the behaviour of Iron under the influence of Heat and Strain. A strained iron wire was heated to redness by a current of voltaic electricity, and then the current being discontinued, was allowed to cool. It was observed that there arrived a moment in the process of cooling at which the wire suddenly elongated, and then gradually shortened, until it became perfectly cold, remaining, however, permanently elongated. No other metal besides iron exhibited this peculiarity, which Mr. Gore attributes to a momentary molecular change; and he points out that this change would probably happen in large masses of wrought iron, and would come into operation in various cases where these masses are subjected to the conjoint influence of heat and strain, as in various engineering operations, the destruction of buildings by fire, and other cases. The phenomenon deserves a further investigation, since every fact relating to iron is of importance to us.

NEW METALS.—HYDROGENIUM AND JARGONIUM.

Those who have followed the chemical investigations of the Master of the Mint, and noted their sequence from the date of his first communication to Thomson's *Annals of Philosophy*, in 1826, to the present time will not have been surprised by his paper lately read at the Royal Society. After what he said thirty years ago as to the nature of hydrogen, and after his "message from the stars" in the occluded hydrogen of a meteorite, a new paper *On the Relation of Hydrogen to Palladium* comes in logical order. Mr. Graham has not yet arrived at the point of laying before the Society an ingot of that highly volatile metal hydrogen; but he states that "the idea forces itself upon the mind that palladium, with its occluded hydrogen, is simply an alloy of this volatile metal, in which the volatility of the one element is restrained by its union with the other, and which owes

its metallic aspect equally to both constituents." This idea he confirms by a series of experiments, in which palladium is charged with 800 or 900 times its volume of hydrogen gas; and to this compound substance he gives the name of *Hydrogenium*.

May we not regard this result, worked out with a cautious accuracy which has always characterised Mr. Graham's researches, as a step towards the ingot of hydrogen? Faraday once solidified different gases before the eyes of a thousand wondering spectators at the Royal Institution. Is it reserved for anyone of our living natural philosophers to show us the solidification of hydrogen?

It appears from the details of the experiments, as read in the paper, that the density of palladium when charged with hydrogen to the extent above mentioned is perceptibly lowered; that the mean density of hydrogenium is 1·951, or nearly 2; that its tenacity and electrical conductivity are less than in palladium, but the conducting power, being 5·99, is yet considerable, and "may be construed to favour the metallic character of the second constituent of the wire," that is, of the hydrogen. On the other hand, hydrogenium is more magnetic than palladium—as 48° to 10°—and, as Mr. Graham remarks, "must be allowed to rise out of the class of paramagnetic metals, and to take place in the strictly magnetic group with iron, nickel, cobalt, chromium and manganese. This fact may have its bearing upon the appearance of hydrogenium in meteoric iron, in association with certain other magnetic elements."—*Athenæum*.

The discovery of another metallic element, by means of spectrum analysis, is again announced—this time by Mr. Sorby, who found it in the course of an examination of some Ceylon hyacinth or jargon (zircon), as the stone is sometimes called. Hence, Mr. Sorby proposes to call the new metal Jargonium. The characteristic spectrum of the supposed new element is a series of black absorption bands, and in connection with these, it is right to mention that Professor Church, who is well known by his researches on some of the rarer and more expensive minerals, had noticed in 1866 that some zircons gave a series of black bands, from which he then inferred the presence of a new element, and proposed the name nigrium for it. Earlier still, Svanberg, by a chemical examination of zircon, came to the conclusion that it contained a till then undiscovered element, which he did not succeed in completely isolating from zirconium, but for which he suggested the name norium. Whether the metals thus independently discovered are one and the same, or three distinct elements, remains to be settled by a more complete examination. We fancy, however, that there can be little doubt that Professor Church's nigrium and Mr. Sorby's jargonium are identical. The minerals which contain these metals are so rare that the discovery is of little importance, except in a scientific point of view. But we must quote one practical application of Professor Church's discovery, which he

pointed out in the *Intellectual Observer* for May, 1866. The orange hyacinth, which shows these black lines very distinctly, is extremely rare, and very precious, and another and cheaper stone, cinnamon-garnet, is commonly sold for it. This latter gives no black bands, and hence the spectroscope affords a ready means of detecting the imposition.—*Mechanics' Magazine.*

COMBUSTION UNDER PRESSURES.

FRANKLAND'S views of the cause of luminosity in a flame are in opposition to Davy's opinion, that luminosity depends upon the incandescence of solid particles. Dr. Frankland asserts that it is a consequence of the density of the atmosphere surrounding a flame. We need now only mention one experiment which is thought conclusive. The flame of pure hydrogen, which is barely visible at the ordinary pressure of the air, becomes more and more luminous as the atmosphere in which it is burning is compressed. M. Deville does not accept Dr. Frankland's conclusion. Pressure, he says, means elevation of temperature, and luminosity depends upon temperature. It is not our intention to enter upon this discussion here, and we come at once to a practical application. Pressure meaning elevation of temperature, M. Deville suggests that the furnaces of engines might be supplied with air under pressure, in which case the products of combustion passing slowly through tubes at a much higher temperature than under ordinary conditions, the extent of the heating surface might be greatly diminished. The application to marine boilers when heated with liquid hydrocarbons is particularly mentioned, and is, perhaps, within the range of possibility. Double work, however, it must be remembered, is imposed on the steam, and the requirement of an extra boiler might counterbalance the advantages of a diminished heating surface. We look forward with much interest to the results of M. Deville's labours. He has an iron room constructed in which he can carry on furnace experiments under a pressure of two or three atmospheres, and we sincerely hope that no accident may happen to prevent him from giving to the world the valuable results he is likely to arrive at.—*Mechanics' Magazine.*

MAGNETISM AND HEAT.

AN ordinary magnet loses its Magnetism when heated. But molten cast iron, surrounded with a helix, through which a strong galvanic current is sent, becomes strongly magnetic, and retains its magnetism as long as the current is continued. This fact has been discovered by M. Treve, who draws some important inferences as regards the magnetism of the earth.

NEW FORMS OF PERMANENT MAGNET.

A DISCOVERY has been made by Mr. F. A. Paget, C.E., which must become a subject of interest among electricians. It

is well known that it is impossible to magnetise a plate except in the direction of its greatest length; and that a square one cannot be made to show magnetic action at all. Mr. Paget, however, finds that by cutting slits nearly up to the middle of a steel plate, a square plate in one piece can with such slits be regularly magnetised; and by this means even an oblong square plate can be regularly magnetised and with as many poles as may be required, in a direction transverse to its greatest length. Mr. Paget also suggests that a parallelopipedon or cube may, perhaps, be convertible in this way into a connected series of magnets. It may be said of course, that it is just separate oblong magnets that are thus made; but they are not separate; and the influence of this Siamese twin sort of connection is just one of those curious points which require investigation. May not the oblong connection be in itself a diamagnet? and if so, the mutual reactions of the diamagnet and the magnets may evolve something new in regard to magnetic and diamagnetic laws.—*Builder.*

CALCULATION OF STEAM-ENGINES.

In 1848, the Council of the Royal Society awarded their Rumford Medal to M. H. V. Regnault for his "Experiments to Determine the Laws and the Numerical Data which enter into the Calculation of Steam-engines," which, with other valuable researches, had been published, to the great advantage of science. The results there given were accurate beyond any then existing, and their value and importance were acknowledged by the President, the Marquis of Northampton, as he handed the medal to (then) Lieut.-Col. Sabine, Foreign Secretary of the Society, who received it on M. Regnault's behalf. Since that date the eminent Frenchman has pursued his investigations, and given them to the world in the second volume of the work above mentioned. They embrace a wide range of experiments; and as Sir Edward Sabine informs us, the amount of labour involved in M. Regnault's researches upon the specific heat of simple and compound bodies, upon the dilatation of gases and vapours, upon the comparison of the air with the mercurial thermometer, upon the elastic force of aqueous vapour, upon the determination of the density of gases, and upon hygrometry, must excite the astonishment of all who can estimate the difficulty of the problems attacked, the precision of the results attained, and the fundamental character of the data which he has determined. We are further assured that the "researches on the specific heat of gases and vapours alone constitute a monumental work." It is a subject on which conclusions the most discordant had been arrived at by experimental investigators of tried skill and ingenuity; and to have cleared away all their perplexing contradictions is no small achievement. Hence we see good reason why the Council of the Royal Society elected M. Regnault years ago one of their fifty Foreign Members, and have now conferred on him

the highest honour in their gift—the Copley Medal. It was regretted by all present that he was prevented from appearing to receive the medal in person by "*des conditions très tristes de famille.*"

PROMOTERS OF VAPORISATION.

A VERY interesting communication made to the Royal Society by Mr. C. Tomlinson records some facts which suggest a wide practical application. Anyone who has observed a liquid boiling in a glass vessel, will have noticed that the bubbles of Vapour start from but a few points, sometimes, indeed, from only one. It is not because that spot is hotter than surrounding parts, but in most cases a minute speck or point may be seen either in the glass itself or adhering to it, and from this the bubbles of vapour stream away. Mr. Tomlinson regards a liquid at or near its boiling point as a supersaturated solution of its own vapour; and just as in supersaturated saline solutions, the introduction of a solid nucleus starts crystallisation, so in the present case, the solid nucleus serves to start ebullition. On one condition, however, the point, or speck, or nucleus, must not be "chemically clean." Chemical cleanliness, we need hardly say, means absolute cleanliness. Many may suppose, that when, for instance, they have washed a glass rod in water and wiped it with a clean cloth, the rod is clean. Not at all; it may be dirtier than it was before. To get it chemically clean, you must put it in strong acid, then rinse it with distilled water, then put it in ether, and finally wipe it, as we may say, with the flame of a spirit lamp. Then for a moment, you may have it clean, but only for a moment; one wave in the air and it is chemically unclean once more. Dirt, however, we know is a very useful thing when in the right place, and some things which we have to regard chemically as dirty, and which indeed refuse to be made clean, are highly useful as "Promoters of Vaporisation," an expression of Faraday's adopted by Mr. Tomlinson. Among these coke and charcoal are the most active, and the results of some experiments made for Mr. Tomlinson suggest the introduction of a bushel or two of one of them into every steam boiler. Thus when water was boiled for twenty minutes in a glass flask alone, 995 grains boiled away, but when some pieces of coke were added, 1,130 grains of water boiled away in the same time. An experiment with wood charcoal had more striking results. Water was made to distil freely from a still, and the quantity collected in fifteen minutes was weighed. Some pieces of charcoal were then added, and the distillate again collected during the fifteen minutes. From the water alone, 262 grains were collected; from the water with charcoal, 334 grains; that is, upwards of one-fourth more water was evaporated when the charcoal was used. These experiments were made under the ordinary pressure, and it is likely that the results under extraordinary pressure will be still better. An incidental advantage will be that the coke or charcoal will prevent, to a great extent, the deposition of crust on the

bottom of the boiler, and so prevent a waste of heat from that source.—*Mechanics' Magazine.*

MR. HUGGINS'S SPECTRUM ANALYSIS.

MR. WILLIAM HUGGINS, F.R.S., has read to the Royal Institution an account of some further results of Spectrum Analysis as applied to the heavenly bodies which had been obtained in his observatory since his discourse in 1865, in which he had been assisted by Professor W. A. Miller. He began by a brief statement of the principles by which spectra should be interpreted, referring to large coloured diagrams, exhibiting, 1, a continuous spectrum, unbroken by bright or dark lines, which indicates that the light has not undergone any modification on its way to us, and that its source is an opaque body, almost certainly solid or liquid, and giving no information of the chemical nature of the substance from which the light emanates; 2, a spectrum of bright lines separated by dark spaces, which informs us that the source of the light is matter in the gaseous state, and by means of which we may discover whether any terrestrial substances exist in the source of light, by comparing the bright lines with the lines of terrestrial flames; and 3, a continuous spectrum interrupted by dark lines, which shows that the light has passed through vapours, which have deprived it of certain refrangibilities by a power of selective absorption. Mr. Huggins then described an application of this method of analysis to the stars in a new direction—as a method of detecting whether they have any motion towards the earth or from it; and he explained how this part of a star's motion could not be recognised by ordinary methods of observation, since a motion in the line of sight would not produce any apparent change of position. After showing by experiments on sound (the production of beats or discord by the rapid to-and-fro movements of two vibrating tuning-forks which were in perfect unison when at rest), he explained the way in which a relative motion of the source of light and of the observer would produce a change of refrangibility in the light, and which would be shown by a minute shift of the position of a line in the star's spectrum; and he stated that, after every care had been taken, he had discovered a minute shift of a line in Sirius, which showed that the star's motion, after making corrections for the earth's motion and for the sun's motion in space, was about twenty-six miles per second from the earth. Mr. Huggins then described the results of a more severe testing with a very powerful spectroscope of the apparent coincidence of two of the lines of the spectrum of the nebula in Orion with a line of hydrogen and a line of nitrogen, which issued in the coincidence being perfectly maintained, making it still more highly probable that the chief constituents of that nebula are hydrogen and nitrogen. He stated that he found, when the brightness of the spectra of these gases was greatly diminished, all the lines were extinguished except the one line in each spectrum coincident with lines in the

nebula; and this, he said, suggests whether the other lines of the gases have been extinguished by a power of absorption existing in cosmical space. Mr. Huggins then gave an account of his examination of the light of two comets last year, both of which gave spectra consisting of three bright bands, but not identical in each comet; and he stated that he found the spectrum of the comet discovered by Winnecke to agree precisely with the spectrum of carbon, which tended to throw light on the nature of cometary phenomena. In conclusion, after exhibiting a beautiful representation of the protuberances on the sun's disc as photographed by Major Tennant, Mr Huggins described a method which he had discovered whereby the form of these protuberances could be seen by the use of coloured glasses.

MR. LOCKYER'S RECENT DISCOVERIES BY THE SPECTROSCOPE.

MR. LOCKYER has discoursed to the Royal Institution on Recent Discoveries in Solar Physics made by the Spectroscope. He began by referring to the conflicting opinions in 1865, respecting the cause of the darkness of the spots in the sun. In England Messrs. Warren De la Rue, Balfour Stewart, Lœwy, and others attributed it to the absorption of the solar light by a cool, non-luminous atmosphere, called the photosphere, pouring down upon the general surface; while French men of science, represented by M. Faye, said that a spot is dark because it is a hole in the photosphere, the feebly luminous radiating gases of the sun being then visible. To test these rival theories Mr. Lockyer, in March, 1866, attached a spectroscope to his telescope, and the results of his observations immediately demonstrated the correctness of the English opinion. As the solar atmosphere was thus proved to be a cool absorbing one, and as during an eclipse the red flames or protuberances give out more light than the corona, Mr Lockyer and Dr. Balfour Stewart reasoned that the protuberances were probably masses of glowing gas, hotter than the corona. After exhibiting illuminated magnified photographs of the phenomena of a solar eclipse, Mr. Lockyer illustrated the train of thought which led to his employment of an increased number of prisms in the spectroscope with the object of diluting or dispersing the continuous spectrum of the solid body of the sun, and thereby causing the lines of the gaseous spectrum of the protuberances to appear. This he tried in 1866, by means of a Herschel-Browning spectroscope; but enough dispersion was not produced, and the effect was not obtained. M. Janssen, however, conceived the method of solving this problem during the eclipse of August 18, 1868; and the very next day succeeded in obtaining spectroscopic evidence of the protuberances which he had seen surrounding the eclipsed sun on the previous day; and he eventually determined that these protuberances are built up of hydrogen. The way in which these important discoveries were made was clearly explained by Mr. Lockyer

by reference to an enlarged and illuminated photograph of the arrangements of his own telescope and spectroscope, and to a series of photographs of spectra. He then proceeded to describe the results of the elaborate experiments of himself and Dr. Frankland; among these he especially referred to the evidence they obtained that the gaseous matter of which the prominences are composed is in a condition of extreme tenuity, and that even at the lower surface of the chromosphere—that is, on the sun itself—the pressure is very far below that of the earth's atmosphere. Instead of the compound atmosphere supposed by Kirchhoff, they found one mainly consisting of hydrogen; and they showed separately that the gaseous condition of the photosphere is quite consistent with its continuous spectrum; that a sun-spot is a region of greater absorption; that when photospheric matter is injected into the chromosphere bright lines are seen; and that there are bright lines in the solar spectrum itself. Thus, it is probable that the absorption to which the reversal of the spectrum and the Fraunhofer lines are due takes place in the photosphere itself or near it, instead of in an extensive outer absorbing atmosphere. Mr. Lockyer next described the beautiful and interesting results which he obtained by observing the sun through an open slit, whereby the smallest details of the protuberances and the sun itself were made visible; and he especially referred to the existence of the convection currents, the up-rushes and down-rushes going on between the sun and its atmosphere; and commented on the effect of violent storms and cyclones in changing the forms of the protuberances, some of which in measurement have been found to be about 27,000 miles in height. He then adverted to the behaviour of some of the Fraunhofer lines, in widening and contracting during these storms, thereby indicating a variation in the pressure of the solar atmosphere; his observations being amply illustrated by illuminated magnified spectra, and drawings of some of the varied forms of the protuberances. "We are now," he said, "furnished with a barometer whereby we may, so to speak, measure the changing pressures of the solar and stellar atmosphere: and now that we have grappled with some of the phenomena of the nearest star, we may soon hope for more certain knowledge of the distant ones."

ZOELLNER'S SPECTROSCOPIC RESEARCHES.

M. FAYE has given at the Academy of Sciences, Paris, a remarkably interesting account of Prof. Zoellner's Spectroscopic researches, from which it will be seen that the use of the spectroscope in the service of astronomy becomes more and more important Prof. Zoellner has devised a new form of instrument, which he calls *Spectroscope à réversion*. It is a curious combination of Bouguer's heliometer with a double set of Amici's direct-vision prisms, and its object is to obtain from a single bundle of luminous rays two parallel but inverse spectra. The apparatus

is so contrived that with a movement, after the manner of a vernier, the rays of two spectra can be brought into coincidence or juxtaposed. Any change of refrangibility in the spectral rays is thus doubled, and can be micrometrically measured by a very delicate process.

To test the degree of precision Prof. Zoellner set himself to measure the interval which separates the two sodium rays, and was convinced that it could be easily ascertained to within $\frac{1}{220}$th of its value. Then taking advantage of certain well-known optical laws, he has in this newly-contrived instrument the means for measuring to within about 800 mètres the movement of the earth in its orbit; and by increasing the number of prisms the exactitude of the result is increased without other limit than the visibility of the spectra under investigation.

Here M. Faye remarks that we seem to be on the verge of a complete solution of the problem to which Babinet has given much time and thought, namely, to measure by the simple displacement of the spectral rays the velocity of the heavenly bodies. Mr. Huggins has already shown in a communication to the Royal Society the rate of motion of Sirius, subsequently confirmed by Father Secchi; and we may infer that the distribution of matter throughout the stellar universe will not for ever remain an enigma.

But besides the star, Prof. Zoellner purposes to measure the rate of the sun's rotation on its axis. Double the sun's image with a heliometer, and bring the two into contact at the equator, one of the two regions near the point of tangency will move towards the spectator with a speed of two kilomètres a second, while the other will move from the spectator at a similar rate. By this displacement of rays, we have a means of measuring the rate of motion with extreme accuracy, and it will be interesting to compare the results hereby obtained with those at which astronomers have arrived by other methods.

The solar protuberances—the red flame, as some observers call them—have not escaped Prof. Zoellner's attention. By widening the slit of his spectroscope (spectroscopists will understand what is meant) he is enabled to see these amazing phenomena distinctly. Indeed, so well defined are their images that he takes photographs of them, and thus has a trustworthy record of the changes which they undergo. As the protuberances can now be observed whenever the sun is visible, he contemplates the construction of a spectroscope with prisms so large, and with a curved slit, that will show them (the protuberances) all at once, as during an eclipse. Prof. Zoellner's observations lead him to the conclusion that they are not clouds floating in the sun's atmosphere, but are produced by vehement volcanic eruptions.

We venture to recommend the *Spectroscope à réversion* to Mr. Browning's attention, and we congratulate Messrs. Lockyer, Huggins, Herschel and Janssen on this addition to the ranks of spectroscopists.—*Athenæum.*

THE STEREOSCOPE.

PROFESSOR SYLVESTER has read to the British Association a paper on "Prof. Christian Wiener's Stereoscopic Representation of the Cubic Eikosi-Heptagram." Prof. Sylvester produced some stereoscopic drawings of the famous complex of twenty-seven right lines discovered by Dr. Salmon (Regius Professor of Divinity at the University of Dublin), which have such remarkable relations of mutual intersection with one another, and admit of being drawn upon a cubic surface, *i.e.* one of the third order. Various attempts had been made by himself and others to effect the visible construction of this eikosi-heptagram, but without success, until, at the request of the illustrious Clebsch, of Heidelberg, Dr. Christian Weiner (Professor of Descriptive Geometry in the Technical Institution at Carlsruhe) built up a suitable cubic surface, and actually drew upon it the twenty-seven straight lines in question. From this solid figure he had taken stereoscopic drawings, and kindly forwarded copies to the author of the communication. Almost contemporaneously with Prof. Wiener's realisation of the figure, M. Camille Jordan had communicated to the Académie des Sciences of Paris a very important application to the theory involved in the figure to those hyper-abelian functions which were to form part of the promised continuation of Mr. Russell's report, brought before the Section that morning. This afforded another instance of the strong reverse action which geometry was now exerting over modern analysis. It should be mentioned that M. Jordan erroneously gives Steiner the credit of the discovery of the eikos-heptagram in question. This great geometer did, in fact, rediscover it for himself in ignorance of the prior labours of the Dublin Professor, having in the later years of his life fallen into the habit, and indeed adopted the rule, of never looking at what proceeded from other brains than his own.—*Athenæum.*

MICA SPECTACLES.

DR. KOHN, of Breslau, proposes Mica Spectacles to protect the eyes from injury by solid bodies, and also—mica being a very bad conductor of heat—from the mischief done to the eye by prolonged exposure to heat rays. The same eminent oculist has investigated the condition of the eyes of a number of compositors, and has made one or two practical suggestions which are worthy of notice. The predominant affection of the eye produced in compositors is short-sightedness, which increases with the length of time the occupation is followed. Out of 132 compositors whose eyes were examined, 68, or 51·5 per cent. were short-sighted, and of these 51 had begun the trade with good sight. The source of the artificial light with which they work seems to have some influence on the production of the diseased state. Thus, of compositors who worked with oil lamps, 66 per cent. were short-sighted, while, of those who worked with gas,

only 50 per cent. were affected—a satisfactory state of things, considering that in this country little but gas is employed. The temperature in the neighbourhood of the eyes, when oil was used, was about 72° Fahr.; and when gas was employed, about 76° Fahr. The higher temperature, in the case of gas, was, no doubt, owing to the employment of the naked flame; and one of Dr. Kohn's suggestions is that the flame shall always be surrounded with a glass, which would, of course, arrest much of the heat. This would involve the use of the circular burners, but this, in the end, would, we believe, be found quite as economical as the bat's-wing and fish-tail now employed. Another suggestion is an arrangement of the shade, to throw the light more on the case, and less on the eyes of the compositor; and, lastly, the disuse of small types, with shorter hours of labour! These are all excellent suggestions, and, we may add, that it will be short-sighted policy if they are not all adopted.

THE SPECTRUM MICROSCOPE.

At a conversazione of the Royal Society, held during the past season, much attention was attracted by Mr. Sorby's exemplifications of the application of the Spectrum Microscope to mineralogy. The flame produced when a certain mineral is subjected to the action of the blow-pipe is analysed by means of the spectroscope, and by this expedient the existence of new minerals has been discovered. Among these is jargonia, an earth closely allied to zirconia, and constituting the chief ingredient of some of the jargons from Ceylon. The natural silicate is almost, if not quite, colourless, and yet it gives a spectrum which shows above a dozen narrow black lines. When melted with borax it gives a glassy bead, and no trace of absorption bands can be seen in the spectrum. But if the borax bead be saturated at a high temperature and flamed, the spectrum shows four distinct absorption bands, unlike those due to any other known substance. By this application of the spectroscope a new and powerful expedient of chemical research is provided, which may reveal differences which would otherwise remain unsuspected.

PROHIBITED DIET.

Professor Edwards, of Montreal, has read before the American Association for Science a paper on the mysterious *trichina spiralis*, concerning which there have been so many alarms in Germany and America. Observed in 1822 by Tiedmann, and minutely described by Mr. James Paget and Professor Owen in 1835, this dangerous parasite was not detected in the human body until Zenker found it there in 1860, and attributed it to the eating of diseased pork. Within the last few years Virchow and Lueckert in Germany, and Dalton have made investigations which lead them to believe that several diseases ascribed to other

causes are really attributable to the ravages of trichinæ. All the known cases of infection from the eating of pork in Chicago, Illinois, ended in death, and the opinion of the German investigators has been that trichinosis is always fatal. The experience of Montreal, however, contradicts this. On the 24th of March last a family in a Montreal boarding-house, having partaken of some hastily-fried ham, were all seized an hour after with nausea and pain in the stomach. One took brandy and vomited his dinner. The rest continued to have sickness and spasms. The ham, being examined, was found to have trichinæ. The patients recovered in the course of a few weeks. In Hamilton, Canada, a young woman died from a similar infection. In the case of those who recovered it was shown, from the undeveloped nature of the cysts containing the worms, that the pig from which the ham was taken had been but recently diseased. The professor, nevertheless, thought that recovery was exceptional. Professor Agassiz, in commenting on the paper, hoped that the public appetite would not be disturbed on the subject, for every kind of meat contained parasites similar in nature. None, he declared, could eat fish without devouring hundreds of such animals; and if they wished to avoid them they would have to abstain from meat altogether. As a lunch of ham sandwiches was daily provided for the association, the paper naturally caused considerable sensation, and Professor Agassiz's remarks hardly outweighed its serious statements.—*Pall-mall Gazette.*

NEW RESEARCHES ON LIGHT AND OPTICS.

At the Meeting of the British Association at Exeter, several novelties relating to Light and Optics were brought forward.

Professor Gustav Magnus has found by experiment that fluor spar reflects the waves of æther thrown off by hot rock-salt more than any other polished surface, out of many substances which he tried. Hence, if these long waves were visible to the eye, fluor spar would sparkle more brilliantly in such rays than would the polished surface of metals.

Dr. Balfour Stewart called attention to some experiments of his own, made a few years ago, tending to prove that the heat rays emitted by rock-salt are very long ones, belonging almost to the extremity of the spectrum. He also found that, despite the general transparency of rock-salt to obscure heat, it shows great opacity to the heat rays emitted by a second piece of its own substance.

Mr. C. Brooke narrated how he and Mr. Browning, the optician, had tried to make rock-salt prisms for use in a heat spectroscope. Supposing the base of the prism to be parallel to the line of cleavage of the crystal, it was found that in nearly every instance the apex of prism split off; and that, as a rule, long before the apex had been ground down to anything like a

sharp edge. They therefore thought they would try the influence of annealing upon the crystal, so put one of them in a tin box full enough of sand to well cover the piece of rock-salt, and with a slow and gradual increase of heat, brought it in the course of a few hours to a very high temperature. It was then allowed to cool very slowly indeed. The result of this treatment was to produce pieces of rock-salt which could be ground into prisms without much danger of the splitting of the crystal.

A paper by M. Morren was read by Mr. R. B. Hayward, M.A., detailing some experiments on the action of Light upon Vapours and Gases confined in tubes. The experiments were of the same nature as those performed by Professor Tyndall, wherein the action of a conical beam of intense light from the electric lamp was seen to set up cloudy chemical decomposition in certain transparent vapours from organic volatile liquids. M. Morren, who lives in the south of France, was able to do away with the electric light, and to use sunlight in its place. His experiments were tried with inorganic substances, so as to render easier the task of deciding upon the actual nature of the chemical decomposition set up by light; and in the course of his researches he discovered a source of error in the method of working adopted by Professor Tyndall. The glass experimental tube was of the same description as that used by Professor Tyndall; it had flat ends of glass, fixed to the tube itself by brass ferrules and cement, the ferrules being fitted with stop-cocks for the exhaustion of the air. M. Morren introduced a mixture of perfectly pure and dry hydrogen and nitrogen gases into his exhausted tube, and on sending a beam of sunlight through the long axis thereof, he was surprised to see signs of chemical action in the shape of the formation of a cloud. This phenomenon led him to suspect that the resinous cement used to fix on the ends of the tube had perhaps liberated some volatile hydrocarbon to mix with his pure permanent gases. He accordingly made another tube, and used cement free from this objection, but the cloud was formed as before. Lastly, he suspected the arrangement for drying the gases, which consisted of powdered glass wetted with sulphuric acid; and on substituting chloride of calcium as the drying agent, no cloud was formed on the repetition of the experiment. In the end, he found out that even the purest sulphuric acid, quite free from arsenic and other foreign substances, liberates traces of sulphurous acid gas, and thereby causes the formation of a cloud. This fact shows that in some cases this method of experimenting is a very delicate test for the presence of certain chemical substances. Moreover, the discovery made by M. Morren affects a large number of the experiments on the action of gases upon radiant heat made by Professor Tyndall, and published by him in his celebrated work, *Heat Considered as a Mode of Motion*. In all those experiments Dr. Tyndall dried his gases by means of powdered glass and sulphuric acid; so that, as shown by M. Morren, traces of

sulphurous acid gas must always have been present in his experimental tube, and influencing the result to a certain extent.

DESCENT OF GLACIERS.

A PAPER has been read by the Rev. Canon Moseley on the "Mechanical Possibility of the Descent of Glaciers by their Weight only," in which it was shown that, inasmuch as the cohesion of the ice of which glaciers are composed was much greater than the force necessary to support their weight, it was impossible that they could descend by their weight alone. In the March number of the *Philosophical Magazine* there is an able paper by Mr. Croll, in which it is shown that, although the cohesive strength of a glacier is sufficient to maintain it *in situ*, yet that it is in reality melted in detail, and portions consequently flow over, so that the effect is much the same as if the whole glacier descended gradually as a pasty mass.—*Illustrated London News.*

CRYSTALLISATION OF SUGAR.

IN a paper addressed to the French Academy of Sciences, M. Dubrunfaut, who has been investigating the subject of the Crystallisation of Sugar, refers to the fact that a loaf of sugar presents different degrees of purity at different points of the loaf. Thus, contrary to what might be reasonably expected, the purest sugar is at the summit of the cone, and that which is least so at the base, the average quality being likely to be found at the section which passes through the centre of gravity. French tradesmen call the outer coating of the loaf *la robe*, the summit *la tête*. These are the two best parts. Then come the *centre* and *la patte*, consisting of the inferior quality.

M. Dubrunfaut considers that all soluble bodies, crystallisable or amorphous, acquire in their solutions a molecular state different from that which belongs to them in a solid state. He describes the following phenomenon:—If a crystallisable substance like sugar be precipitated from its solution by means of concentrated alcohol, one of the following alternatives will take place—either the sugar will momentarily remain dissolved in a state of apparent, but not real, supersaturation; or it will be precipitated in the shape of viscous clots, resembling those produced under similar circumstances by gum, dextrine, &c.. Examined through the microscope these clots present a globular texture, which, nevertheless, are in the end transformed into well-defined crystals.

FOSSILISED LIFE.

DR. JENZSCH, of Gotha, announces that in various kinds of crystalline and volcanic rocks he has discovered minute animal and vegetable forms in prodigious numbers and in a fossil con-

dition. Some of these minute creatures he describes as having been petrified in the midst of their "life functions." Among them he finds infusoria and rotiferæ, intermingled with algæ, and he infers their formation in a large expanse of stagnant water. By the publication of a small book on the subject, Dr. Jenzsch offers means for testing the accuracy of his conclusions.

EARTHQUAKE PHENOMENON.

In the *Proceedings of the Asiatic Society of Bengal* for June last, we find a statement of the effect of an Earthquake which is worth notice. In November, 1868, a shock was felt in the district of Murwut. The underground moisture at that season is commonly found two feet below the surface; but it rose after the earthquake to about six inches below the surface, not in one spot only, but throughout all the light sandy tracts of the district. In consequence of this rise, "numbers of villagers who, on account of the drought, had for a time deserted their villages, returned, and, with those who had remained, at once commenced ploughing and sowing." It is only right to mention that the occurrence of this phenomenon has been questioned; but the Deputy-Commissioner who reports it states that he was in Murwut shortly afterwards, and satisfied himself of the truth. The sandy soil exhibited its usual dry, parched appearance, but on scraping the surface a little the moisture was at once rendered apparent. Perhaps some of our geological readers will be able to say whether there is any similar instance of such a phenomenon on record.—*Athenæum.*

DARWINISM.

The following papers were read to the British Association on this important and interesting question:—

"Man *v.* the Animals: being a Counter-Theory to Mr. Darwin's as to the Origin of Species," by Archdeacon Freeman.—The author said that the question raised by Darwin was already an international one. In England great names ranged themselves on either side; in France, De Quatrefages, Langel and others disallow the theory; while in Germany, Fritz Müller and Fraeckel warmly espouse it. But what is wanted is a compact counter-theory, accounting for all the phenomena on which Darwin's rests, while free from the difficulties which beset it. It is not enough to allege objections, however serious. Mr. Darwin confesses to them, but believes them to be not insuperable. Now, there is a very ancient view, entertained by Plato, and countenanced, to say the least, by Scripture, as to the process or order according to which the production of the world, the animal world included, took place in the Divine working. It is that certain ideals pre-existed, and that after these the creatures were formed. Man certainly was created after a pre-existing image, that of God himself. And of the higher animals, the lion, the ox, the eagle, we seem to be distinctly told that the ideal

existed before in the form of the cherubim. And man is there exhibited as on a par with them, and they with him. Especially, it is said that they were, in certain respects, anthropomorphous. They all had the likeness of a man, and the face and the hands of a man (Ezekiel i. 5, 8, 10). And their employment is described in the Revelation, iv. v. as that of conjointly glorifying God. Now, this mysterious representation only shadows forth with marvellous accuracy what science and observation teach us about the higher animals. They are anthropomorphous; their organisation, limbs, digitation, expression, intelligence, emotions, all are intensely human. But, whereas Darwin would account for this by supposing a common descent and slow graduation of the species with each other, we are thus helped to a widely different view. The purpose of all being to unite with man in glorifying God, whether by the exercise of common powers of action, feeling, and intelligence, or by aiding him, it is perfectly natural that they should have had impressed on them from the first a common type, both of bodily and mental organisation. It is an ennobling badge of brotherhood between creatures serving in their degrees the same purpose. The sum is then, the species, or great orders however, were created at once, as the Bible tells us, but with an affinity and uniformity of which a very sufficient account can be given. And this view does not exclude, but welcomes, the observed phenomena of "natural selection," considered as accounting for a certain degree of variation in the creatures. But it sternly defines that there are strict limits to that variation, that, as Mr. Ruskin says (*Queen of the Air*, 1869), "the species may mock us by deliberate imitation of each other."

"The Difficulties of Darwinism," by the Rev. F. O. Morris. This paper was read by one of the Secretaries of the Section, in the absence of the author, and contained an enumeration of many facts which the author could not account for on the Darwinian hypothesis, but which Mr. Darwin himself and others have fully considered.

"Philosophical Objections to Darwinism and Evolution," by the Rev. Dr. M'Cann. After various preliminary remarks, Dr. M'Cann said that Prof. Huxley acknowledged that, in the present creation at any rate, no intermediate link bridges over the gap between man and the apes. But, this being so, evolutionism must be false, even according to Mr. Darwin himself. The hypothesis was also opposed to man's progress, ignoring every inducement that could be urged to stimulate man to do the right and true. Prof. Huxley's lecture "On the Physical Basis of Life" was severely handled, and considered to contain many untenable statements. He concluded by urging that evolutionism must be false on any supposition that may be adopted, and, consequently, ought to be rejected.

Prof. Huxley disclaimed any desire for controversy, but felt called upon to say something, as he had been personally alluded to. He would not notice the second paper (that of Mr. Morris), since it was a mere repetition of objections which had been an-

swered over and over again. It was one of the most annoying things to which men of science were subjected to be called upon incessantly to reply to arguments which had been completely shelved. With regard to Dr. M'Cann's paper, he would make some observations. He did not understand that "brotherly love" which seemed to him to be so often the synonym of a very different kind of emotion. He sometimes thought it not improbable that Abel was the first man of science and Cain the first theologian. Dr. M'Cann had come forward in the name of philosophy, but he (Prof. Huxley) protested, in the name of philosophy, against such shallow pseudo-philosophy as that which they had just heard. The view for which Dr. M'Cann had endeavoured to make him responsible was really that of the excellent and pious Bishop Berkeley, of Cloyne. Dr. M'Cann had started with the veracity of consciousness. Now, the formula of Descartes had been long ago exploded, as the author should have known. It was an entire fallacy in the way in which Dr. M'Cann had used it. A man may be conscious of a feeling that he calls brotherly love—so far the affirmation of consciousness may be trusted; but that it is really "brotherly love" is another question altogether. A single object, such as a marble, may be made, when applied to the fingers crossed one over the other, to give the impression of two objects If the affirmation of consciousness were true in Dr. M'Cann's sense, it would be true that there were two objects, and not one only. Mr. Morris had caricatured Darwin's hypothesis, but Dr. M'Cann had not done this, for it was necessary to understand a matter before you could caricature it. Prof. Huxley had recently published a paper (his reply to Mr. Congreve on Comte's Philosophy), for which his friends told him he ought to receive the highest rewards the Church had to bestow. Dr. M'Cann ought to have been acquainted with that paper when he made the charges he had made. In that paper he had stated that he considered the question for and against free-will as a balanced one at the present time, and one which would probably always remain so. It was not right under those circumstances to call him a necessitarian or a materialist. The first paper, that by the Archdeacon, was a great contrast, from its honesty and the manner which characterised it. He had been delighted to hear the Archdeacon, for his way of looking at things was so novel that he should have to make quite a new pigeon-hole in his classification of men for his special reception. He had generally found that theologians hang on to certain dogmas or doctrines till their fingers are burnt, and then, letting go, say it is of no importance, or was not meant in the sense which they have been contending for. Now, the Archdeacon did not do this, but was honest and consistent. As to his theory of the cherubim, it was essentially the same as the Platonic doctrine of Archetype, which has been advocated by Owen and Agassiz. He had had great pleasure in listening to the Archdeacon, though he need not say that he totally dissented from his views.

At the close of the discussion the President said that not any one of the three authors had shown any knowledge of what the Darwinian theory really was. The general notion that it taught that man was descended from the apes was quite false, since it did nothing of the kind.

ZOOLOGICAL REAPPEARANCE.

PROF. LOEWEL, of Stockholm, while dredging in the Strait of Tornea, discovered Zoophytes hitherto unknown among the existing fauna, but which show a close analogy to certain crinoids. Here, then, as Prof. Milne-Edwards remarks, is a real zoological re-appearance of animal forms which had completely disappeared from remote geological periods. What is the zoological or geological significance of this interesting fact? and are there many more secrets to be revealed from the bottom of the sea?

MICROSCOPICAL EXAMINATION OF DUST.

MR. J. B. DANCER has reported to the Manchester Literary and Philosophical Society that he had made some Microscopical Examinations of Dust collected in June, July, and August last, and also of the particles contained in the rain water after the long drought. He proposed to carry on observations during every month in the year, for the purpose of recording the average amount of solid matter deposited in a given area, and also as far as possible to ascertain the character of the deposits. The observations so far had shown, as might have been expected, that the dust in various localities, at different altitudes, and under other varying conditions, contained particles differing in magnitude, appearance, and quantity for the same superficial area. In every instance, molecular activity was abundant, but the animal life was very variable in amount, the largest number of moving organisms being in the dust collected at the lowest points; this was about 5 ft. above the surface of the earth. This dust also contained the largest proportion in magnitude and quantity of vegetable matter. These observations also showed that in thoroughfares where there were many animals engaged in the traffic, the majority of the light dust which when disturbed reached the average height of 5 ft., or about the level of a foot passenger's mouth, consisted of a large proportion of vegetable matter which had passed through the stomachs of animals, or which had suffered partial decomposition in some way or other. That was not an agreeable piece of information, but it was a fact. It showed the necessity, in a sanitary point of view, of the streets being well watered before the scavengers were allowed to commence operations; otherwise the light dust was only made to change its locality, and was not properly removed. It was not pleasant to contemplate the possibility of germs of disease being wafted along with that decaying matter, and inhaled by those whose condition might be favourable for its development.—*Mechanics' Magazine.*

Electrical Science.

GREAT INDUCTION COIL.

ONE of the greatest scientific wonders of the age is unquestionably the Great Induction Coil—or inductorium, as the German physicists term it—at the Polytechnic Institution. It is an instrument of remarkable power and capacity, and possesses the highest scientific interest. In designing this induction coil, which is about six times as large as any previous production of the kind, Professor Pepper's object was to obtain an easily controlled source of electricity, combined with a degree of tension sufficient for the scenic requirements of the Polytechnic Institution. To Mr. Apps, of the Strand, is due the construction of the present powerful machine; but, although so extremely powerful, it is nevertheless perfectly safe to the manipulator, so carefully has every contingency of accident been guarded against. The machine consists of an ebonite barrel, 9 ft. 10 in. in length, supported at each end on two ebonite pillars. The barrel was made at the Silvertown Works, and is the largest ever turned out there. It contains the compound coil, and of itself weighs 477 lb., the whole machine weighing 15 cwt.

The primary wire is of copper of the highest conductivity, 0·0925 in. diam. (B.W.G., No. 13), and 3,770 yards in length; the number of revolutions of the primary wire round the soft iron core is 6,000, its arrangement being three, six, and twelve strands. The total resistance of the primary coil is 2·201400 British Association units; and the resistances of the primary conductors are respectively, for the three strands, 0·733800; for the six, 0·366945; for the twelve, 0·1834725 B.A. units. The soft iron core is composed of straight wires of very soft iron, each wire being 5 ft. in length, and 0·0625 in. in diameter. The diameter of the bundle of core wires is 4 in., and their weight 123 lb. The secondary wire is 150 miles in length, 0·015 in. (B. W. G., No. 29) diameter, and is covered with silk. The total weight of the wire is 606 lb., and its electrical resistance 33,560 B.A. units. This secondary coil is 4 ft. 2 in. long, and the insulation is calculated for safety at 95 per cent. beyond absolute requirement. The secondary wire is insulated from the primary by an ebonite tube 8 ft. in length and ¼ in. in thickness. The condenser is made with sheets of varnished paper and tinfoil, arranged in six parts, each containing 125 ft. super., or a total of 750 ft. super.

The machine was originally tried with a contact breaker detached from the great coil, and having an independent electro-magnet; this worked well up to ten Bunsen cells with the great inductorium, but when the battery was increased to thirty or forty

cells it became unmanageable. A Ruhmkorff break, with platinum amalgam and alcohol above it, was substituted, which saved the points, but the spirit was now and then violently ejected and set on fire. Professor Pepper then proposed a modification, which has proved successful, remaining in perfect working order during a series of experiments extending over eight hours. The commutator regulating the admission of the battery current is provided with a locking apparatus, and the whole coil is most carefully and effectually insulated from the floor and surrounding apparatus, as are also the separate portions of the apparatus from each other. The battery power is at present supplied by forty Bunsen cells, each containing a pint of nitric acid. It is, however, intended to substitute for this a Grove's battery of the largest size ever made. It will consist of pipeclay cells, 2 ft. square upon the sides and 3 in. wide, with walls an eighth of an inch thick.

In working the great induction coil, the sparks obtained from it with five Bunsen cells are 12 in. in length; ten cells give sparks 14 in. in length; fifteen cells give 17½ in. sparks; twenty cells give 21 in. sparks; twenty-five cells give 23 in. sparks; thirty cells give 24½ in. sparks; thirty-five cells give 26 in. sparks; forty cells give 27½ in. sparks; and with fifty cells, sparks from 28 in. to 29 in. in length were obtained. After eight hours' working, the coil gave, with fifty cells, a spark 25½ in. in length. It was also found that of the proportions of the condenser used, one-half gave the longest spark. The spark is not such as is generally produced under similar circumstances, but is a thick wire of light, surrounded by a wide waving flame 2 in. or 3 in. thick, and which can be blown aside from the spark. The spectroscope gives a perfectly continuous spectrum, like the light of day, only that it is barred with the bright lines of the substances in combustion. The flame of the spark, with a very slight blast of air, rises to at least 12 in. in height when it is passing about the same distance horizontally.

Besides the gigantic Grove's battery, a Leyden battery has been constructed. There is also a very large and elegant arrangement of Gassiot's cascade, which is also to work with the great induction machine, and which will embody several important improvements that have been suggested by Mr. Gassiot. The most recent experiments with the coil have shown that as yet no limit as to the quantity effects can be established, and it is exceedingly probable that, by a very few minutes' working, the large coil would charge at least 1,000 Leyden jars of very large size. The coil, too, is probably destined to throw a new light upon scientific research, and to solve the problem—what is ozone? In reference to the amount of this element and the density at which it may be produced, very few experiments have as yet been made. But enough is seen in the extraordinary reddening effect of the flame of the spark on litmus paper, to show that we are likely very soon to solve the ozone problem.

Dr. Richardson has conducted a series of experiments with this huge induction coil. He finds that the spark from the coil itself, which measures 29 in. in length, has no injurious effect when directed against a living body. A pigeon was experimented upon, having been first put to sleep by bichloride of methylene. It was connected by the foot with the negative pole of the coil, and one or two discharges sent through the body. There was a general muscular contraction at each discharge, but the heart's action and the respiration remained perfectly healthy. In fact, the bird was perfectly uninjured, save as to the feathers, which, strange to say, were somewhat singed. A toad also passed the same course with satisfactory results. The escape of the animals in these cases is due to the ready course of the current over their bodies. In fact, the body internally is not traversed by the current at all, but is surrounded by it.—*Mechanics' Magazine.*

POWERFUL BATTERY.

A Galvanic Battery of great power is described in the French journals. Two carbons are placed together in a large porous vessel with a mixture of bichromates of potassium and sodium, and perchromate and persulphate of iron. In the outer vessel zinc and a saturated solution of common salt are used. The poles are to be placed as near together as possible, and to be of the greatest extent possible. It is easy to see that such a battery must be of great power. For equal size, it is said to have twice the power of the bichromate battery with two liquids, and eight and a half times the force of the single liquid bichromate battery. The uses for such a battery are not numerous, but, when great intensity is required, and an instrument of small bulk is convenient, this combination may be recommended.

NEW GALVANIC BATTERY.

A Galvanic Battery, which will be found very convenient under some circumstances, is described by M. J. Ney. A plate of amalgamated zinc is immersed in solution of chloride of ammonium, or, if the battery is to be carried about, may be set in sand wetted with a solution of the chloride. The copper plate is set in a porous vessel filled up with carbonate of copper—the common mineral carbonate will answer the purpose, it is said. This combination, which is certainly cheap, gives, we are told, a lasting and strong current. It bears some resemblance to Jacobi's chamber battery, and, like that, is available where acid batteries are objectionable. The action consists in the decomposition of the sal-ammoniac, the chlorine of which goes to the zinc, while the ammonia passes to the carbonate of copper. When exhausted, the action is revived by the addition of sal-ammoniac.

Writing of batteries reminds us that amalgamated iron plates

have been recommended for use in place of amalgamated zinc, the iron being much cheaper, and electrically of very nearly the same value as the zinc. But to amalgamate the iron has been a difficulty. Several methods have been suggested, more or less troublesome and expensive; but the following is comparatively simple, and is said to answer extremely well. The iron, carefully cleaned, is first done over with a solution of chloride of copper in hydrochloric acid, and thus a thin coating of metallic copper is obtained on the surface. Upon this a solution of bichloride of mercury in hydrochloric acid is applied, and the whole surface becomes amalgamated. Whether the mercury really combines with anything more than the superficial coating of copper is more than we can say at present. But we are told that the coating completely protects the iron from rust. Various applications for this discovery suggest themselves—one mentioned by the author is, as we have said, the use of amalgamated iron plates in batteries.—*Mechanics' Magazine.*

NEW DYNAMO-ELECTRIC MACHINE.

At the Berlin Railway Science Society, Herr Siemens has given some particulars about a New Dynamo-Electric Machine, of his own construction, in which the weakening effect of the opposite inductive currents is got rid of. By means of galvanic batteries and charcoal points we know an electric light can be obtained of the illuminating power of 500-600 candles, but the new dynamo-electric machine, the motive power of which is a steam-engine of 8-horse power, produces a current which emits from the charcoal points a light equal to that of 2,395 candles.

NEW THERMO-ELECTRIC PILE.

A New Thermo-Electric Pile is described by MM. Mure and Clamond, in which galena forms the negative element and iron the positive. The galena is cut into bars 40 millimetres long and 8 millimetres thick, and thin sheet-iron plates, 55 millimetres long and 8 millimetres wide, are connected. The inventors arrange a series of these so as to form a hollow cylinder, in which a gas-burner is placed. The insulations, we should have said, are made with thin plates of mica. Although with forty of these couples the intensity of one Bunsen cell is obtained, it is hardly necessary to say that we are a long way from getting the electric equivalent of the heat employed.

MILITARY ELECTRICITY.

Mr. Abel, F.R.S., Chemist to the War Department, has given at the Royal Institution a very interesting lecture on "Some Applications of Electricity to Naval and Military Purposes." The lecturer confined his remarks to the use of electricity for land or water mines. Franklin in 1751, and Priestley in 1767, sug-

gested the possibility of applying the electric spark for the ignition of gunpowder charges, but the first practical application was made by the French military engineers about thirty years ago, after Volta had discovered the properties of the pile which bears his name. Not long afterwards English military engineers employed the same apparatus to destroy the Round Cliff at Dover, and remove the wreck of the *Royal George*. Since then many instruments have been devised to act either by heating a piece of thin wire introduced into the circuit, or employing a magnetic arrangement to give a spark which shall pass through a very sensitive explosive composition, and so create the first heat necessary to fire the whole charge.

The lecturer rapidly sketched the history of manifold inventions, French, English, American, German, and Austrian, carrying forward the first ideal to the point now attained, when a hundred mines can be exploded simultaneously by electrical agency. Mr. Abel himself designed one of the best fuses that have ever been used for the purpose. In the Abel fuse a spark, generated by revolving magnets, is made to pass through a mixture of subphosphide of copper, subsulphide of copper, and potassic chlorate—materials which are of high conducting power, yet extremely sensitive to the action of the spark. This is most important, for the electrical spark passes with such rapidity as frequently to dash away from it without igniting the compositions exposed to its action. This fuse and the apparatus which inflames it have long been used for the proof of guns and experimental practice. But the most important military application of the means for exploding charges of gunpowder or gun-cotton is, doubtless, to be found in the employment of torpedoes. The Russians tried torpedoes to be fired by electricity during the Crimean war; but the mines themselves were too small, and the electrical arrangements deficient in certainty. A far better arrangement was invented by Baron von Ebner, of the Austrian Engineers, and employed by him in defending the approaches to Venice in 1859, and again, with further improvements, in 1866. In neither of these years was there an opportunity for trying the new agent in actual war; but the Americans made much use of mechanical and electrical torpedoes in their great struggle. Many a channel was blocked by them, many a Federal and even Confederate ship was blown up by torpedoes.

A Committee appointed to investigate this subject in England has prepared a most elaborate report, which is intended to be kept strictly confidential. Mr. Abel was secretary to the committee, and important revelations were expected; but the lecturer was careful to avoid anything of the kind. The English system is, however, so far developed as to render its instant application to coast defence possible in case of threatened attack. The new torpedoes can be laid down rapidly in large numbers, rendered sensitive or not at pleasure, and fired by the blow received when the vessel strikes them. Thus, our own ships can pass to and

fro over them when they are left out of circuit; but if the enemy's fleet approaches, the operators on shore can, in a moment, place the whole array of hidden mines in complete preparation, so that when any one of them is struck it will explode, and break the back of the unwary vessel, or blow a large hole in her beneath the water-line. Furthermore, means have been devised for testing each torpedo at any time after it has been laid down, and as often as may be wished. Numerous classes of officers receive instruction in torpedo warfare, and there can be no doubt that submarine mines will be hereafter largely employed, both as auxiliaries to forts and as protections to unfortified coasts or harbours. In the latter case a few light gunboats or floating batteries must be ready to prevent the enemy from fishing up and carrying away the dangerous inventions. Mr. Abel's lecture was illustrated by a series of highly successful experiments. We understand that the French, following our English improvements, are taking up the subject of gun-cotton. We know that great interest has lately been excited in several countries by reports of Mr. Abel's discoveries in the use of the new explosive agent, and we most sincerely hope that England will not allow herself to be left behind in its practical application.—*Times.*

ELECTRICAL SEWING MACHINE.

A Sewing Machine driven by Electricity may now be seen in actual use in Paris. The foot is now no longer needful; the "hand" has only to direct the work of the needle. The invention, although the machine can only be adapted for the lightest work, may be worthy of attention here. The arrangement for producing the movements will be familiar to every electrician.

WHALE-CATCHING BY ELECTRICITY.

The dangers and uncertainties to which those who are engaged in the Whale Fisheries are exposed render that occupation most perilous and hazardous. These dangers and uncertainties arise, firstly, from the distance at which the harpoon is necessarily thrown to strike the whale. Secondly, from the unsteady motion of the boat at the time the harpoon is thrown, rendering it almost impossible to wound the whale in a vital part. Thirdly, from the whale, when struck, diving to the bottom of the sea, or swimming off at a great velocity and towing the boat with him, thereby frequently upsetting it, and endangering the lives of the crew. And lastly, from the whale, in his exertions to get free, breaking the line by which the harpoon is attached to the boat and escaping with it, thus rendering all the toil and labour of the crew of no avail. To obviate all this, Messrs. Bennett and Ward, of New Broad Street, City, have patented a method of capturing whales by the agency of electricity, galvanism, or magnetic electricity. It consists in placing in the boat or in the

whaling vessel a galvanic battery, with its coils and necessary accompaniments, or any other electrical apparatus of any required intensity. Properly insulated wires are placed in connection with and pass from the opposite poles or terminals of the battery, and along the lines by which the harpoons are secured to the boat. The ends of these wires are continued to the points of the harpoons, so that the points shall be in direct communication with the poles of the battery. When practicable, two harpoons are thrown into the whale at the same or nearly the same time, and when the battery is charged, the electric currents will pass along the wires to the points of the harpoons, and through the body of the whale, thus completing the electric circuit. Harpoons may be thrown simultaneously from other boats, by which means the same result will be attained. The whale (if the battery and its accompaniments are sufficiently powerful) will be paralysed by the electric shocks, and will lie on or near the surface of the water without the slightest motion, so that the boat can approach sufficiently near to spear and capture the fish without the possibility of the occurrence of the dangers to which we have referred.

When it is not possible to throw the two harpoons at the same time into the body of the fish, it will, in some cases, be sufficient to have the extremity of one pole of the battery in the water as near to the whale as possible, while the harpoon attached to the other pole of the battery is injected into the body of the fish. Two harpoons may be bound together so as to form a single harpoon with two separate barbed points parallel to each other, the two component parts of which are insulated from each other, the wire from each pole of the battery passing down or through either part of this compound harpoon to the point, thus forming the electric circuit. Of course, in all cases where any instruments, such as harpoons, spears, &c., are likely to be brought into contact with the human frame, they are efficiently insulated at the points. It is not absolutely necessary that the instruments should enter into the body of the whale, as, if the poles of the battery are merely in communication with the skin of the whale, the same effect will be produced. In this way, electricity may be employed in the capture of seals and many other fish and sea or river animals.

For salmon and river fishing generally, the inventors of the system propose that the insulated wires in communication with the battery shall pass through fishing rods (themselves properly insulated), the wires being continued in the form of a metallic thread properly insulated. When the salmon or other fish is hooked, another line may be thrown as near the first as possible, and the electric current caused to pass from the hook in the fish's mouth to the other line. Or two persons may have their rods and lines in close proximity to one another during the time they are fishing, in which case no time will be lost in throwing the second line. Again, a double hook upon the same

principle as the double harpoon may be employed, so that, the instant the bait is seized by the fish, it will become paralysed and unable to disgorge the bait. Another plan proposed is to have a galvanic battery placed on the bank of the river, one of its poles being placed in the water at one side, and the other conveyed across the river to the other side. It will be found that fish passing or remaining between the two terminals of the battery will be paralysed and float at or near the top of the water, when they can be easily caught by a net or otherwise. Another proposal of the patentees is that wires from the battery shall pass partially around an ordinary net, so that fish passing into the net will be paralysed and more easily captured. Such is the theory of fishing by electricity.—*Mechanics' Magazine.*

ELECTRO-ASTRONOMICAL EXPERIMENTS.

The United States Coast Survey officers have been engaged for some time past in making Astronomical Observations, by the aid of Telegraph, between the cities of the Far West and Cambridge University. For the purpose of arriving at the difference in mean time between San Francisco and Boston, the wires of the Western Union Telegraph Company have nightly been connected, for nearly a month past, from one side of the continent to the other, and the ticking of a chronometer in Cambridge University has been observed and recorded in San Francisco with a most remarkable degree of accuracy. This is done by connecting the pendulum of the chronometer at Cambridge with the wire, in such a manner that the main circuit is broken and instantly closed again at every beat or tick of the timepiece, and the result is that each second of time, as marked by the chronometer at Cambridge, goes forth from the University on the Atlantic coast, and, with almost the speed of light itself, hurries on over the magic wire, passing through intermediate cities, towns, and villages, across rivers, over mountains, and along the open country, until it finally reaches the recording instrument on the Pacific coast in all its original fulness of pulsation.

At any time during an evening of the past month, says the *Buffalo Courier*, a visitor to the operating rooms of the Western Union Telegraph Office might have heard one of the little instruments beating the measured time of the sixtieth part of a minute, with the monotony and regularity of a chronometer itself. Tick! tick! tick! One, two, three, four, five minutes elapse, and then the little monitor ceases. Back comes the answer from San Francisco to Boston: "All right; your second signals came good, and have been recorded for five minutes. Go ahead five minutes more'" Again, Tick! tick! tick! for five minutes, and then San Francisco says again: "All right; are you ready to take my signals?" And the answer from Boston is: "Yes; go ahead." Tick! tick! tick! says San Francisco for the allotted five minutes, and Boston says, in his turn, "All right."

But notwithstanding the speed with which these pulsations of a clock fly from one side of our continent to the other, it is known that there is a loss, a very slight loss of time in the transmission. How to arrive at this loss, and measure it, is the next question. Nothing easier; a second wire is switched into place, a "repeater" added to Boston, and, presto! 'tis done. Now the clock ticks made at San Francisco rush on the wings of light over the 3,000 miles of wire to Boston, and back again to San Francisco over the second wire, and record themselves at the point of starting, in something less than 60 seconds of time, having, in the interval, traversed 6,000 miles. The successful completion of this last experiment has been witnessed, and the flight of electricity was actually measured, so to speak, as easily as one measures a yard of muslin.

Never before in the world's history has such a wonderful feat been attempted, and that this has been brought to a successful conclusion is due entirely to the beautiful working of the Western Union Company's wires, together with the assiduous attention and superior ability of its employés. Trace the route on the map, and mark the immense distance so lightly glided over by the subtle fluid. The route is from Boston through Albany, Buffalo, Detroit, Chicago, Omaha, Cheyenne, Salt Lake City, and Virginia City, to San Francisco, and this route is of course doubled, forming, for all practical purposes, but a single circuit.

ELECTRIC BEACONS.

MR. THOMAS STEVENSON, C.E., Edinburgh, has conducted an experiment at Granton with the view of showing the practicability of illuminating Beacons and Buoys at sea with the Electric Light, produced by means of a battery on shore. A submarine cable, fully half a mile in length, was laid between the east breakwater of Granton harbour and the chain pier at Trinity. The operator occupied a station near the centre of the breakwater, and the light was shown at the point of the pier in front of an ordinary lighthouse reflector, producing a most brilliant flash. The flashes were emitted with great rapidity; as many as 500 can be transmitted in a minute, but the machine can be regulated so as to send one every second, or at any other desired interval. The experiment gave entire satisfaction.

ELECTROLYTIC IRON.

DR. JACOBI has read to the British Association a paper on the Electro-deposit of Iron. The learned Professor illustrated his remarks by a series of plates of extreme beauty. The solution from which the metallic iron was deposited consisted of a double salt, the sulphate of iron and magnesia. It was found desirable to coat the recipient of the deposit with a thin film of nickel or copper. Specimens illustrating the application of the electro-deposit of iron to purposes of engraving (aided by photography were also exhibited.

THE NEW FRENCH ATLANTIC CABLE.

When the idea of an Atlantic Telegraph was first proposed, in 1856, it was, naturally enough, thought impossible to perfect it, and it was also not unnaturally thought that the cable would never last long enough to pay. The practical touchstone of commercial profit was applied to it at every stage of its conception and working out, and it is almost needless to say that the new scheme got very much the worst of it in these theoretical calculations. The event amply justified the foreboding predictions. The first Atlantic cable, badly made and badly laid, "gave out," as the Americans say, after about three weeks' uncertain work, and was a total loss. It needed no little enterprise and confidence to find funds for another cable after this, but they were forthcoming, and the second, well made and well laid cable, snapped in mid-ocean in 1865. Like the spider's web, the huge thread was spun again in 1866, and with what results the world now knows. Not only was the cable of 1866 laid most perfectly, but from the tenacious depths of the mid-Atlantic the broken wire of the previous year, after lying more than a twelvemonth beneath nearly three miles of stormy water, was searched for, found, raised, and re-united to its broken half, and a second submarine line to America completed. It was thought that the two lines would never pay, as they were not likely to work long. One has now been down three years and the other four, yet the electrical tests show them to be rather more than 20 times better as regards conductivity and insulation than on the day on which they were first submerged. As regards the business transacted through them, it has steadily continued to increase, and the two lines now have about as much as they can well do, and their earnings average about 700*l.* a day. It is not strange, under these circumstances, therefore, that another candidate comes into the field for a share of the convenience, the profit, and the honour, and that the French wish to have an independent line for themselves. This will make the third line to America, and we would almost venture to say that before ten years are past there will at least be half-a-dozen wires laid to that great continent.

Owing to the monopoly which granted to the Anglo-American companies the sole right of landing cables on Newfoundland for 100 years, the course which the French line will take differs much from that of the English cables. For the same reason, arising from the necessities of the different depths, the new cable may be called composite in all but its conductor and its insulation, which are alike throughout. To either extremity there is a distinct shore end, and from this to the deep sea cable there is an intermediate length of peculiar manufacture. The deep sea portion is almost similar to the Atlantic cable of 1856, and where the French cable differs it differs for the better. The total length of the cable required for this route will be no less than 3,564 nautical miles, or very nearly double the length of either of our

Atlantic cables. One length of 2,788 knots will be required from Brest to St. Pierre, and 776 from St. Pierre to Massachusetts. The distance between Valentia and Heart's Content is in a straight line only 1,670 nautical miles, but for the cables 2,400 miles had always to be made to allow for slack and in case of accidents. In the cable of 1865 only 1,890 miles have been used, and in the cable of 1866 only 1,851 miles. The French company therefore made every proper allowance for slack and whatever unforeseen eventualities may arise.

The deep sea portion of the cable is almost precisely similar to the two present Atlantic lines. In principle of construction they are all exactly the same. The conductor of the Atlantic cables is formed of one strand of seven copper wires, and it weighs 300 lb. to the mile. The French conductor is twisted in the same way, but it weighs 400 lb. to the mile, which is certainly an advantage. Round the conductor come four folds of gutta percha, interlaid with four coatings of Chatterton's insulating compound, which is found to work well. Round all come ten galvanized homogeneous iron wires done up in strands of Manilla hemp. In the present cables this hemp was plain, in the French cable it is saturated in tar, which is another advantage for preservation, though perhaps a disadvantage in paying out. Its weight is 15 cwt. a mile in water, and 31 cwt. a mile in air. Its breaking strain is a little over 7 tons, so that it can support a length of nearly 10 miles in water without much danger; and as the greatest depth in which it will have to be laid is not more than two miles and a half, the risk from breaking may be said to be *nil*. The shore ends are the same as the shore ends of the old Atlantic cables, and weigh nearly 20 tons to the mile. Their breaking strains are supposed to be about 60 tons, but it really would be almost impossible to break them. They would moor the *Great Eastern* herself. About 20 miles of this tremendous bar wire—if one can apply the term wire to metals which are almost as thick as pokers—is laid on each side of the Atlantic. To these shore ends, which taper gradually away, is to be joined a length of about 70 miles each way of what is called intermediate cable. The core of this cable is, of course, constructed in precisely the same way as the rest. It is only the outer covering which differs. This, as much of it rests in not more than 100 or 150 fathoms of water, is made much stronger, to guard against chafing on rocks. Instead of 10 wires done up in hemp strands, therefore, it is covered with 12 much thick wires of plain galvanized iron, and then coated to a thicknes some half an inch all round with Latimer Clark's silica com pound, which has been found to answer with marked success the Persian Gulf cable. At the termination of these so-cal intermediate portions the deep sea cable we have already scribed is continued across the Atlantic to near St. Pierre.

It is in the nature of all practical sciences to advance, an in spite of all improvements which seem to leave nothing to

desired, to keep advancing every year. In nothing is this great truth more strongly exemplified than in the manufacture and working of submarine cables. Every new one is better than that which preceded it. In the Malta and Alexandria cable it was thought that at last true perfection had been attained, but the next one for the Persian Gulf was better still. The Atlantic cable of 1865 was better than that again, the cable of 1866 better still, and this last French cable is likely to be the best of all. The standard of the manufactured value of a cable is judged by what are called its units of resistance. There is always a certain amount of resistance to the passage of the electric current through the conductor, and the more perfect the insulation of the cable the greater that resistance will be. This amount of resistance is measured by the galvanometer, and is counted by millions of units. Thus, a cable which gave a resistance of only one million of units would at once show that it was defective, and by some hidden leakage allowed the current to escape, and so, of course, allowed it to enter the wire faster than it could have done had it been so carefully insulated that all the electricity must have passed along the conductor, and along that only. Bad materials, which absorb the current, will also give rise to a low rate of resistance, and a low rate of resistance is only a scientific term for a bad cable. The Indian Government insisted on the Persian Gulf cable having a uniform standard of resistance of 50,000,000 units, and this pitch of excellence was thought to be almost unattainable, yet it was done, and more than done. The standard for the Atlantic cable of 1865 was then raised to 100,000,000 units, and that, too, was accomplished. In the cable of 1866 the standard of resistance was raised to 150,000,000 units, and now in this French cable the contract standard is that it must have 250,000,000 units of resistance, and no less. Thus the two Atlantic cables have gained so much in insulation since they left the factory that often during last year, it is said, they gave a resistance as high as 4,000,000,000 units.—*Abridged from the Times.*

WEST INDIA AND PANAMA TELEGRAPH.

With this cable it is proposed to make a most important extension of submarine telegraphs, and which will in time become more important still when the Government of Peru has completed the arrangements it is now making for a wire which will connect the West India system by a telegraph of alternate land and sea lines along the whole line of the South-west Pacific coast from Panama to Valparaiso, and thence across La Plata, to [illegible] Ayres and Montevideo, whence there is already an [illegible] complete land line along the eastern coast of South [illegible]a up to Rio de Janeiro. The cable made by this West [illegible] Company consists of 2,550 miles of submarine cable with [illegible] miles of land line. It is difficult to fix the cost per mile at

which the cable will be made, for as it passes through very varying depths of water, in some parts over what may be called shallows, and in no part at a greater depth than 600 fathoms, the cable varies also in its form of manufacture. It is of what may be called the composite kind—that is, very thick where the water is shoal, very light and strong where the sea is deep, and with two lines of intermediate cables for the intermediate depths. This contract has been taken by the India-rubber, Gutta Percha, and Telegraph Works Company, at Silvertown, where the cable, and where every process in the long and elaborate system of manufacture can be seen, from the first twisting of the copper strand at one end of the works to the finished cable running out into the tanks at the other.

Between Cuba and Florida a submarine line has been laid by Sir Charles Bright, which connects the land lines of Cuba with Key West, and thence all over the States, and by the French or the two English submarine Atlantic lines to all parts of Europe. The new line which the West India Company are about to lay will connect these Cuban lines, and therefore the lines of America and Europe, with Jamaica. From Kingston the line takes a north-easterly bend, passing up to Porto Rico, thence to St. Thomas's, and so on down south again, calling at the islands of Gaudaloupe, Martinique, Barbadoes, Tobago, Grenada, and Trinidad. From Trinidad it goes on to the main land of South America, touching at Georgetown, where it is landed, and so on by land to New Amsterdam and Surinam. At all the places we have mentioned there are stations. From Kingston, Jamaica, there is to be a branch line passing straight to the Panama land lines at Aspinwall.

We have said that the cable will be composite in its outward form and weight; that is to say, that its conductor and its insulation will be the same internally. It is only in the strength of the outer covering of wire that it will in some parts be made thicker and heavier than others. Thus, from the many landing-places at which the cable will touch, there will be an unusual length of these shore ends—at least 100 miles in all. These ends will all be very massive, though not so massive as the shore ends of the present Atlantic Cable, which have an amount of strength not required on the West India line. It is made of a double sheathing of iron wires, the outer one of twelve very powerful galvanised iron wires, or rods we might almost call them, and the inner sheath of fourteen smaller wires. Both the inner and outer sheath are bound round with hemp, soaked afterwards in tar, and both are also coated outside with Clark's compound, which is understood to be one of the best for protecting cables from the injury which is sometimes caused in shallow water by the attacks of submarine animalculæ. These little devastators, however, fortunately never touch the gutta-percha. The intermediate cable is of very much the same strength as the inner sheathing of the shore ends, and is covered in with

twelve strong wires. The strong deep-sea portion is very little less in size than the intermediate, and is very like the first old Atlantic cable, though nearly twice as heavy and certainly more than four times as strong, for it is sheathed with twelve small wires, but all of solid homogeneous iron. It is merely for convenience sake, however, that this part of the line is called deep, for of deep sea in the general modern meaning of the term—that is, 2,000 or 3,000 fathoms—the West India line has none to encounter. The greatest depth along the route is only 600 fathoms, and the greatest single stretch from station to station little more than 600 miles—a mere trifle when we consider what the science of cable-laying has now been brought to. The different sections we have mentioned will be so tapered in their construction as to be reduced at the point of junction to the exact diameter of the smaller part of the section they are next to join with.

The whole process of manufacturing a cable is a most curious series of operations. From the time that the lump of raw gutta-percha enters the works, very much in appearance and fibre like a compressed ball of dried stable manure, till it is shredded, boiled, cleaned, steamed, melted, macerated, mixed, and re-macerated, and pours out pure to be forced through dies round the copper conductor, the visitor never loses sight of it. When the first coat has been given—and in this cable there are three, with a coating of insulation between each—the process of putting on coat after coat is of course all alike. Here, however, the copper conductor is placed in connection with the batteries to detect faults, and on the first sign of loss of insulation the alarm bell rings, and the works are stopped till the cause of leakage is discovered and the part cut out. The minimum standard of resistance of the present cable is fixed at as high as 300,000,000 units, or 50,000,000 units of resistance higher than the last French cable, and 100,000,000 units higher than the standard under which both the English cables were constructed. This raising of the standard of excellence every year shows conclusively how much more perfect the manufacture is becoming, both mechanically and scientifically. Before leaving the works, the West India cable, to avoid all risk, is to be tested in water of 75 degrees up to as high as 500,000,000 units.—*Times.*

Chemical Science.

RECENT PROGRESS OF CHEMICAL SCIENCE.

Dr. Debus, President of the Chemical Section of the British Association, stated the actual progress to have been so great that it would be impossible within the limits of an address to give even a bare outline of the more important work done during the year. Dr. Debus endeavoured, under these circumstances, to direct attention to the ideas which at present guide chemists in their researches—to place in a clear light the objects they are striving to attain, and to indicate the direction of the scientific thought of our time.

The speaker referred, in the first place, to the molecular arrangement of the atoms of which bodies are composed, and said that the views of chemists relative to the combinations of atoms in molecules, and to the methods of ascertaining this arrangement, have undergone great alterations and received great additions during the last ten or fifteen years. To a consideration of these changes he invited the attention of his audience. Eighteen years ago Professor Williamson read before the members of the Association a remarkable paper which contained the germ of our modern chemical doctrines, and was the cause of many important discoveries. He proposed to regard three large classes of bodies—acids, bases, and salts—from the same point of view, and to compare their chemical properties with those of one single elected substance. For this term of comparison he chose water. The speaker proceeded to say:—Now, water is composed of three atoms—two of hydrogen and one of oxygen. Williamson showed that all oxygen acids, all oxygen bases, and the salts resulting from a combination of the two, can, like water, be considered to be composed of three parts or radicals, two of the radicals playing the part of the hydrogen atoms in water, and the third that of the atom of oxygen. Potassic hydrate is water which has one of its atoms of hydrogen replaced by an atom of potassium; hydric nitrate is water which has one atom of hydrogen replaced by nitric oxide; and potassic nitrate is water with one of its hydrogen atoms replaced by nitrate oxide and the other by potassium. This speculation, as every chemist knows, is well supported by experiments; it embraces three large classes of bodies which till then had been considered as distinct. Mr. Gerhardt, in 1853, extended Williamson's views by distinguishing two other types of molecular structure, represented respectively by hydrogen and ammonia; and succeeded, by help of the radical theory, in arranging the majority of the then known substances under the one or the other of the three types already mentioned. Like every theory which is in harmony with experience, the above considerations led to results of unex-

pected importance; for it soon became apparent that the radicals which thus replace hydrogen in water are not at all of the same chemical value.

Dr. Debus then entered into an elaborate and technical explanation in proof of this statement, and then went on to say:— "Thus every year produces results which improve our conceptions of the atomic and molecular constitution of bodies; and as our knowledge improves, new questions suggest themselves and our power over the elements increases. It has already become possible to prepare in the laboratory bodies of a very complex character, and which a few years ago were only found in the bodies of animals or plants. Alizarin, the beautiful compound of the madder root, has been obtained by artificial means in the course of the year by Messrs. Liebermann and Græbe. Results of such a nature render it highly probable that at no distant period it will be in our power to prepare artificially nearly all, if not all, the substances found in plants and animals. Here I must not be misunderstood. Organic structures, such as muscular fibre or the leaves of a tree, the science of chemistry is incapable of producing, but molecules like those found in a leaf or in the stem of a tree will, no doubt, one day be manufactured from their elements.

"I must not conclude this address without reference to two or three subjects of great importance. Professor Bunsen of Heidelberg has published a paper on the washing of precipitates. Every one acquainted with practical chemistry knows how much time is often lost in waiting for a liquid to pass through the filter. Bunsen found the rate of filtration nearly proportional to the difference between the pressures on the upper and lower surfaces of the liquid. If, accordingly, the funnel be fixed air-tight by means of a perforated cork to the neck of a bottle, and the air exhausted in the bottle, the liquid will run faster through the filter in proportion to the diminution of the pressure in the bottle. Comparative experiments, some made according to the old and others made according to the new method, showed that the filtration, washing, and drying of a precipitate, which took seven hours by the old plan, could be performed by filtration into an exhausted bottle in thirteen minutes. But a saving of time is not the only advantage of the improved method of collecting and washing precipitates A more perfect washing with less water than is required by the common way of proceeding is by no means the least recommendation of Bunsen's ingenious method."

CHEMICAL AFFINITY.

A VERY important paper on the nature of Chemical Affinity has been submitted to the French Academy by M. Dumas, in which he maintains that the doctrines first promulgated by Newton upon this subject best accord with chemical phenomena. By affinity we understand the force which causes simple substances to unite with other simple substances to form compounds, and this force

is only exerted when the particles of the bodies are in apparent contact, and becomes extinct when the distance of the particles from one another is appreciable. The term "affinity" was first used by Barchusen, and first defined by Boerhave. But it is the same species of force which Newton distinguishes as one variety of attraction. The record of Newton's chemical experiments is lost; but, in his "Optics," he says, "Since metals dissolved in acids attract but a small quantity of the acid, their attractive force can reach but to a small distance from them. And, as in algebra, where affirmative quantities vanish and cease there negative ones begin, so, in mechanics, where attraction ceases there a repulsive virtue ought to succeed. And thus Nature will be very conformable to herself and very simple, performing all the great motions of the heavenly bodies by the attraction of gravitation which intercedes these bodies and almost all the small ones of their particles by some other attractive and repelling power which intercedes the particles." Ampère has given the complement of this view by showing that the shape of the component particles limits the number of combinations which two elements can produce; Meyer has shown how the impact of the combining molecules upon one another produces light, heat, and electricity; and M. Dumas shows that, whereas the attempt to explain chemical phenomena by a distinct unknown cause or by electricity has yielded no fruit, the attempt to bring it under the laws of universal attraction reveals an accordance with the most advanced knowledge of facts such as could hardly be maintained unless the hypothesis were true.—*Illustrated London News.*

DILATATION OF GAS.

The heat consumed in internal work when a gas dilates has been investigated by M. Clausius, and more recently by M. Moutier, who, at the beginning of 1868, contributed a paper on the subject, printed in the *Comptes Rendus*. The heat required to raise the temperature of a body consists in general of three parts—first, that expended directly in producing the elevation of temperature; second, that consumed in internal work; and, third, that consumed in external work. Mr. Joule and Sir William Thomson have succeeded in demonstrating the existence of internal work in a gas which expands without performing any external work by noting the diminution of temperature which accompanies the flow of the gas. In the case of water raised into steam, part of the heat is expended in overcoming the cohesion of the water, just as heat is expended in liquefying ice. Water cleared of air by boiling or otherwise manifests a strong cohesive or attractive force of the particles for one another. They have a less attraction for air or other foreign bodies; and hence, when foreign particles are thrown into boiling water, the steam appears chiefly to come out of them, as the steam is chiefly generated where their surfaces touch the water.—*Illustrated London News.*

MANUFACTURE OF CHLORINE.

Mr. W. Weldon has read to the British Association a paper "On the Manufacture of Chlorine by means of perpetually-regenerated Manganite of Calcium." What has hitherto been the ordinary process of manufacturing chlorine consists in digesting ores containing peroxide of manganese with hydrochloric acid. The chloride of manganese, which is a residual product of this process, has hitherto been ordinarily thrown away. Mr. Weldon decomposes this chloride of manganese by lime, adds a second equivalent of lime, and then blows air through the resulting mixture of hydrated protoxide of manganese, lime, and solution of chloride of calcium. This quickly converts a perfectly white mud into a perfectly black mud, the protoxide of manganese absorbing oxygen from the infected air, thereby becoming converted into peroxide, which combines with the equivalent of lime used in excess of the quantity required to decompose the chloride of manganese, forming therewith a compound which the author believes to be a new one, and which he calls manganite of calcium. The compound thus produced is employed instead of manganese ores for the liberation of chlorine from hydrochloric acid, and is then reproduced from the resulting solution of chlorine of manganese, and so on continually, the same manganese being thus used perpetually over and over again. The author exhibited samples of manganese which had already generated chlorine forty or fifty successive times. Last year there were made in this country and on the Continent about 120,600 tons of bleaching-powder, which is the principal commodity in the manufacture of which chlorine is employed, and this bleaching-powder cost on an average about *5l.* per ton for native oxide of manganese. Mr. Weldon's process produces bleaching-powder at a cost of only *15s.* per ton for manganite of calcium, and enables much more chlorine to be obtained from a given quantity of hydro-chloric acid than has ordinarily been obtained therefrom hitherto. The process is being very extensively adopted both in this country and on the Continent.

PREPARATION OF OXYGEN.

Gasworks for the production of oxygen on the system of M. Tessié du Motay have been established in New York, in which, by the use of the manganite of soda which is alternately exposed to the action of steam and atmospheric air, oxygen is absorbed from the atmosphere and is then discharged by the steam. The manganite of soda is heated in iron retorts 2 feet in diameter, and 6 feet long. Each retort holds 900 lb. of the manganite; but, as if pure it would fuse, it is mixed with some of the oxides of copper and manganese. The steam is conveyed into the retort through a perforated pipe led along the bottom, and, after passing up through the manganite, escapes in the same way as the gas in gasworks, carrying the oxygen with it.

When the oxygen is expelled the steam is turned off and a stream of air is passed through the pipe, which restores to the manganite the oxygen it had lost before; and it is then in a condition to be acted upon by the steam, and so on, indefinitely, as there is no waste in the manganite. The manganite yields 14½ per cent. of its own weight of oxygen, and a considerable part of this is given out and re-absorbed each time the steam and air are introduced.

PEROXIDE OF HYDROGEN IN THE ATMOSPHERE.

The information comes all the way from Tiflis, in Persia, that peroxide of hydrogen has been discovered in the air. Schönbein, who had no doubt of its existence in the atmosphere, never succeeded in demonstrating its presence. This success, however, is claimed by Mr. Struve. Along with the peroxide of hydrogen, the discoverer always finds ozone and nitrate of ammonia. These were also found in hail and in sea water. In these days, when the origin of nitrates of water is so warmly debated in connection with the question of the possible previous sewage contamination of water, we are fortunately reminded by M. Deville of the fact that he collected snow on the Andes, at the height of about 4,000 ft., which yielded a large amount of nitric acid, doubtless derived from nitrite of ammonia, which Struve has now discovered in the air.—*Mechanics' Magazine.*

PURITY OF HYDROGEN GAS.

A discovery has been made by M. Sallet, somewhat interesting, in these days, to gas examiners and makers. If any solid body be pressed upon the nearly colourless flame of pure hydrogen gas, the flame is seen to be suddenly coloured blue. The cause of this has never before been explained by chemists, but M. Sallet tells us that it is caused by the vapour of sulphur in the gas. As the hydrogen is supposed to be pure, the question arises, whence comes the sulphur. According to our author, it comes from the reduction of sulphates always in suspension in the air, and more particularly from sulphate of sodium. Soda salts, we know, are everywhere present in the atmosphere.

M. A. Poppe has contributed to Poggendorff's *Annalen* an account of an investigation of the cause of the flickering of a gas flame proceeding from a Bunsen's burner, adopting the same expedient which Magnus employed in investigating the constitution of a jet of water. Between the eye and the flame a disc was interposed in which a radial slit was cut, so that the whole length of the flame could be seen when the slit was parallel to it. On rotating the disc with a certain velocity the flame was found to have an undulatory motion, and by giving to the disc such a velocity that it made just one rotation in the time required for the succeeding wave to take the place of the first one,

the flame appeared stationary, and the true form, which is that of an unduloid with a circular section, was at once revealed.—*Illustrated London News.*

NITROUS OXIDE GAS TO PREVENT PAIN.

A VERY valuable Report has been made after numerous carefully conducted experiments on the human subject and on animals. It states,—1st, that the pure gas, so administered as to preclude the inhaling of any atmospheric air with it, is a powerful anæsthetic—more rapid in its action, although more evanescent in its effects, than chloroform and the other anæsthetics now in general use; 2nd, that if its administration were pushed beyond a certain point, it is capable of producing death; but 3rd, that even when death appeared most imminent from its use, the allowing the animal to breathe fresh air, in most cases, brought it rapidly round. It must not, however, be imagined from this that nitrous oxide is an anæsthetic suitable for relieving pain generally. It is suited only to dental and surgical operations which last for, at most, a very few minutes. Its advantages and disadvantages are thus summed up in the report before us:—Advantages.—1. The rapidity of its action in producing anæsthesia, the time required for this being from 63 to 81 seconds. 2. The rapidity with which patients recover from its effects, as an anæsthetic; the time required for this being, according to the same table, from 100 to 120 seconds; and patients generally recovering so completely, as well as quickly, as to be able to walk, speak correctly, and write with a steady hand within four minutes from the commencement of inhalation. 3. It is more agreeable to most patients, being, when pure, quite tasteless. 4. It is less irritating to the air passages, coughing or struggling for free respiration being rarely witnessed after its use, except in cases of very nervous persons. 5. The comparative freedom from nausea and vomiting after its use, the average number of cases where actual vomiting has occurred being under 1 per cent. 6. The absence, as a general rule (after the recovery of complete consciousness), of giddiness, headache, and many other unpleasant effects, which are well known to follow the use of chloroform and other anæsthetics. Disadvantages.—1. Its unsuitableness for long operations, owing to the shortness of its anæsthetic effects. 2. Its unsuitableness (or at any rate ineligibility) for operations followed by much smarting and pain, for the same reason. 3. Where very delicate operations have to be performed, the inconvenience to the operator arising from the muscular twitchings which often occur from its use. 4. This gas is more troublesome to administer, and requires more complicated and cumbrous apparatus than any other anæsthetics do. 5. The inconvenience arising from the trouble of transporting this gas, as compared with other anæsthetics. 6. Its expensiveness, and the difficulty of procuring it in a pure and efficient state for use at all times, if wanted on an emergency.—*Scientific Opinion.*

ATMOSPHERIC AIR AND GAS.

THE effect of Atmospheric Air in diminishing the illuminating power of Gas when the two are mixed together has recently been investigated by two very able experimentors, Dr. Silliman and Professor Wurtz. Their results, which differ somewhat from those of previous experimentors, may be summed up in a few words. When gas is mixed with anything else less than five per cent. of air the loss of illuminating power is a little over one-tenth of a candle for every one per cent. of air. With more than five per cent. and up to twelve per cent., the loss rises to half a candle for every one per cent. of air. Above twelve and up to twenty-five per cent., however, the loss of illuminating power is but four-tenths of a candle for the one per cent. of air. Twelve per cent. of air, they tell us, destroys forty per cent. of illuminating power. The experiments of MM. Audouin and Bèrard, made for the municipality of Paris, show a higher rate of loss than this, while those of Schultz are to a certain extent in accordance. He gives, as a general statement of results, a loss of half a candle for every one per cent. of air. The last-named experimentor, however, made the observation that with very rich cannel gas no loss of illuminating power, but rather an increase, took place up to twelve per cent. of air. If this be established the information will be very useful to cannel gas makers.

TEMPERATURE OF FLAMES.

A PAPER by M. E. Vicaire, on the Temperature of Flames and Dissociation, appears in the *Comptes Rendus*, in which the results stated to have been already obtained by M. Deville are confirmed and expanded. Fluidity, vaporisation, and dissociation appear to be merely stages of the same progress, since ice is melted, water vaporised, and steam decomposed by the application of different degrees of heat. The temperatures of melting, vaporisation, and dissociation are all affected by the pressure.

GAS FOR LIGHTHOUSES.

A PARLIAMENTARY PAPER presents some information on the substitution of Gas for oil as an illuminating power in Lighthouses. It appears that oil gas has been used for four years at the Howth Bailey, at the north entrance of Dublin Bay, and that it is far superior to the previous light. In a report presented to the Board of Trade by Professor Tyndall in June, 1869, he states the result of his inspection of this lighthouse and observation of the light for several successive days and nights in that month. He compared it with the most powerful oil lamp employed by the Commissioners of Irish Lights, a lamp consisting of four concentric wicks, which give rise to four concentric cylinders of flame. The gas burner includes, under ordinary circumstances, 28 jets;

but to these can be added in succession, when required, four additional circles of burners, each embracing 20 jets. Tried in a dark room, the gas flame with 28 jets had more than double the illuminating power of the four-wick oil flame, the advantage increasing with additions to the burners until, with 108 jets, the gas had 15 times the power of the oil lamp. Observations from a point on the North Wall, at six miles distance, were disturbed by the obstruction of the oil lamp by one of its sashes. Observations were afterwards made from Poolbeg. With the 28-jet gas burner it was impossible to say which of the two lights was the best. With an oiled calico screen in front of the lights, roughly to represent a fog, the gas flame had slightly the advantage. The 68-jet burner was then lighted; the decided superiority of the gas flame was immediately apparent; it exhibited a very brilliant globe of light. With the 108 jets the light was truly splendid; the oil flame, which, when burning alone shone brilliantly, appeared to shrink and pale before the flame of the 108-jet burner. The coal employed is a Scotch cannel, delivered at Howth at 35*s.* a ton. It yields an exceedingly rich gas. The Howth Bailey gas, the 28-jet burner, is considerably cheaper than the oil flame; and the great increase of illuminating power which the employment of gas places at the disposal of the keeper on foggy nights is a consideration of the very highest importance. Mr. Tyndall recommends the continued comparison of the oil flame with the higher powers of the gas burners in foggy weather. In rock lighthouses gas would be out of the question; but there are various points on our coasts at which its introduction would not be difficult. Neither its manufacture nor the construction of the burner may, at present, have reached its *maximum* perfection; and with the view of attaining this and of extending the basis of our induction, Mr. Tyndall recommends the further encouragement of this system of illumination in Ireland. It is in use at Wicklow Head. In Scotland experiments reported by Messrs. Stevenson were not so much in favour of gas as to induce them to recommend its adoption there.—*Times.*

POISONOUS GAS IN WELLS.

A SAD accident that has happened at Windlesham serves to illustrate how much ignorance prevails with regard to the danger of descending into wells, and with regard also to the means by which that danger may be discovered and obviated. It seems that a poor man who was engaged in sinking a well went to his work in the morning, was lowered down by his wife and another labourer, and on reaching a certain depth became unconscious, and fell into the water below. A Mr. Charles Mason, a nurseryman, heard the screams of the wife, and instantly descended in the hope of being able to rescue the labourer, but in reality, of course, only to share his fate. A second Mr. Mason, a brother of the first, then descended, but first had a rope made fast to

him. He also became unconscious, but was hauled up by the rope, and recovered. The earlier victims were raised after a time; but in both of them life was extinct. Now, it cannot be too widely known that such calamities as these, which cannot be called accidents, are caused by the presence of carbonic acid gas, the choke damp of the miner, which has passed into the well from some rift in the strata cut through, and which sinks by reason of its weight. No one should ever descend into a well without first lowering a lighted candle. On reaching the carbonic acid gas the candle goes out; and, when this happens, human life will also be extinguished. No descent must be attempted until the gas has been pumped up, which is usually done by pushing down a bundle of straw or a bag stuffed with straw, and hauling it up again, until the air is changed, and the candle will burn. The necessity for this precaution is so generally understood by well-sinkers, that it is difficult to conjecture how it came to be neglected in the present instance. It is still more remarkable that Mr. Charles Mason should not have known that where a man had just fallen he could not himself exist; and that he was going to certain death without the slightest prospect of being able to render any assistance. The hauling up again of his brother probably served in some degree to change the air, and to facilitate the subsequent proceedings.—*Lancet.*

ANALYSIS OF SEWAGE.

A PAPER has been read at the French Academy of Sciences by MM. Mille and Durand-Claye, civil engineers, on the Chemical Analysis of the Liquid Matter of Sewers. It was ascertained that the waters of the sewers of Paris could easily be purified by means of sulphate of alumina, at a cost of one centime per cubic metre of liquid. The 190,000 cubic metres of the latter, which are daily allowed to run to waste, contain a quantity of useful matter, the value of which amounts, in the course of the year, to about 280,000*l.* The operation of purifying the waters divides the fertilising substances as follows:—The phosphates remain in the sediment; the potash is in dissolution in the liquid; one third of the nitrogen is absorbed by the water, the two other thirds by the sediment. [Experienced engineers state that the cost of taking the sewage of London beyond Barking to Sea Reach would have greatly exceeded the total cost of the metropolitan system of main drainage as executed, and that the area requisite to utilise the sewage would not be less than 70,000 acres. It appears in the evidence attached to the Report that as compared with guano at 11*l.* a ton, the chemists' annual value of the London sewage is not less than 1,000,000*l.*]—*Builder.*

SOLUBILITY OF LEAD AND COPPER.

DR. PHIPSON tested a number of specimens of commercial Lead used for domestic and other purposes; the result of his experi-

ments is that lead, copper, and perhaps zinc, are metals which can be dissolved in water at ordinary temperature, and in presence of air when submitted to friction, and that the water need not be so pure as the Surrey spring water in order to exert this solvent action.

IRON AND STEEL.

Dr. B. H. Paul has read to the Chemical Society a paper "On the Connection between the Mechanical Qualities of Malleable Iron and Steel, and the amount of Phosphorus they contain." A discussion followed the reading of this paper, in which Dr. Miller said he had found very unusual quantities of phosphorus even in samples of high class iron. The experiments proved that the presence of from two to three parts of phosphorus in 1,000 of iron was not so detrimental as was generally supposed. In reply to the President, Professor Miller said the phosphorus probably existed as phosphide. It was most certainly eliminated in the form of phosphate. Dr. Price has yet to learn that 24 per cent. of phosphorus could be present in steel without injuring the metal. He believed the method by which the phosphorus was separated as phosphate of iron and then determined with magnesia was absolutely correct, and less tedious than the molybdate method. Mr. Forbes could not agree with Dr. Miller, that the amount of phosphorus in iron was under estimated. The molybdate process was thoroughly understood in Sweden, where they would not receive for making steel iron that contained one per cent. of phosphorus.

USE OF GRAPHITE IN THE BESSEMER PROCESS.

In the Bessemer process very good results are obtained with grey pig iron, but far inferior with white pig. The difference in the two irons is mainly in the proportion of graphitic carbon they contain. Hence it has occurred to Herr Brunner to make use of some Graphite in the first stage of the Bessemer process, but the results do not seem to have been very satisfactory. Better, it would seem, are obtained by sending wood-charcoal dust, with the blast, according to the plan of Herr Stockher.

SILVER AND SULPHUR.

The loss of Silver which results from the impregnation of our atmosphere with Sulphur compounds, especially where gas is burned, is very great. It has been said that many thousands of pounds worth go down our sewers annually in the form of dirt from plate-cleaning, and the loss of one large house on Cornhill from this source has been described to us as serious. Silversmiths may, then, thank one of their confraternity—Herr Strolberger of Munich—for a happy thought. He seems to have tried various plans to save his silver, if possible. He covered his

goods with a clear white varnish, but found that it soon turned yellow in the window, and spoiled the look of his wares. Then he tried water-glass (solution of silicate of potash), but this did not answer. He tried some other solutions, to no purpose; but at last he hit upon the expedient of doing his goods over with a thin coating of collodion, which he finds to answer perfectly. No more loss of silver and no longer incessant labour in keeping it clean. The plan he adopts is this:—He first warms the articles to be coated, and then pays them carefully over with a thinnish collodion diluted with alcohol, using a wide soft brush for the purpose. Generally, he says, it is not advisable to do them over more than once. Silver goods, he tells us, protected in this way, have been exposed in his window more than a year, and are as bright as ever, while others, unprotected, have become perfectly black in a few months.

A non-poisonous silvering solution—non-poisonous, at all events, in comparison with the cyanide solution, which allows no time for the use of antidotes—though not, possibly, altogether harmless, may be found useful, especially when it can be applied without the use of electricity. The inventor takes one part of nitrate of silver, and dissolves it in twenty parts of water. To this solution he adds half a part of sal-ammoniac, and precipitates the silver as chloride, which he again dissolves by the aid of two parts of hyposulphate of soda. Afterwards he adds to the clear solution two parts of a milk of chalk and water. When used, the mixture is shaken up, a little poured into a saucer, and rubbed over the article to be silvered with a tooth-brush or a linen rag. After rubbing a short time, and rinsing with water, the article, it is said, will be found beautifully silvered.—*Mechanics' Magazine.*

OXIDATION OF PHOSPHORUS.

Dr. Moffat has communicated to the British Association a paper "On the Oxidation of Phosphorus, and the Quantity of Phosphoric Acid excreted by the Kidneys in Connection with Atmospheric Conditions." The author stated that while the readings of the barometer are increasing, and the wind is veering northwards, phosphorescence diminishes in brilliance and ozone in quantity, and that while the polar current continues the barometer attains its maximum, phosphorus becomes non-luminous, and ozone disappears. If, he continued, when the wind has veered through the polar points of the compass, the barometer readings begin to decrease, the wind sets in from points by south, phosphorus becomes luminous, and ozone appears; and while the equatorial current continues the barometer falls to a minimum, the wind veers from south to west, phosphorus becomes brilliant, and ozone is in maximum quantity. Dr. Moffat next remarked that liquid and gaseous bodies, when in contact with phosphorus in a non-luminous state, become phosphorated, and that they, under suitable conditions, become phosphorescent

and ozonised, the temperature of which phosphorescence takes place varying with the pressure of the atmosphere. From these observations, and from the fact that venous blood contains phosphorus (phosphorated fat), which on coming in contact with the oxygen of the air during respiration is converted into phosphoric acid (the blood, perhaps, being ozonised at the same time), combines with the alkalis and earths in the liquor sanguinis, and forms phosphates of soda, magnesia, and lime, the author did not think it unreasonable to suppose that the quantity of phosphates formed in the system and eliminated from it, is in some degree determined by the pressure of the atmosphere and the state of the weather generally.

Some experiments have been made in France to determine the cause of the poisonous action of phosphorus, and it is found to be owing to the absorption of oxygen from the blood. It is ascertained that pyrogallic action produces nearly identical effects.

MANUFACTURE OF PHOSPHORUS.

An invention has lately been patented in England for the treatment of materials intended to produce Phosphorus directly in the presence of the fuel inside a blast furnace, in which the combustion is accelerated by the application of an air blast. The invention is due to M. Claude Brison of Châlons-sur-Saône, France. The principal advantage of this new application of blast furnaces in combination with blowing machinery, consists in substituting for the laboratory apparatus hitherto employed for this purpose an industrial apparatus—namely, the blast furnace of simple construction and operation, thus really rendering the manufacture of phosphorus an industrial operation capable of being carried on on a large scale. This apparatus may be employed with equal advantage for producing both varieties of phosphorus, namely, the ordinary phosphorus and the amorphous phosphorus.

The apparatus employed consists of a furnace of fire-brick enclosed in a sheet-iron casing, at the top of which is a cast-iron hopper, for receiving the materials, which is closed by means of a valve capable of being raised by a lever. The materials to be acted upon, together with the fuel, are filled into the chamber of the furnace, where they are heated to a high red heat, the combustion being intensified by the action of a blowing engine. They attain their highest temperature when they arrive at the tuyères; the gaseous products of combustion and the vapours of phosphorus escape at the exit pipes, while the slag or cinder collects in the space, from which it is run off through the passage capable of being closed.

The operation of the apparatus is as follows:—After having brought the chamber to a red heat by the use of fuel only (coke or charcoal), it is filled with fuel to about the height of the pipes, from which point it is filled with alternate layers of fuel and of

the mixture intended to produce the phosphorus. The valve is then closed, and a blast is forced in of sufficient pressure to force the liberated gases through the water of the condensing vessels. The blast is continued as long as alternate layers of the carbonaceous and other materials are introduced into the furnace. The mixture employed for producing the phosphorus consists of phosphate of lime, silica, and carbonate of soda, the whole thoroughly desiccated. The addition of the soda has for its object to form the double silicate of soda and lime, which is more fusible than the silicate of lime alone. When the mixture arrives at the part of the furnace where it attains its highest temperature, the silica liberates the phosphoric acid from its combination with the lime, and this acid is reduced by the excess of carbon. If any part should escape reduction it would soon become decomposed in passing through the carbonaceous layers in the upper part of the furnace, in the presence of an atmosphere surcharged with carbonic oxide The phosphorus escapes through the pipes, which convey it to the condensers. In this process, therefore, the phosphate of lime is attacked by the silica, producing silicate of lime; the phosphoric acid is in its turn reduced by the carbonic oxide, which, in taking up the oxygen from the phosphoric acid, is converted into carbonic acid, and liberates the phosphorus.—*Mechanics' Magazine.*

NEW COLOURING MATTERS.—SUBSTITUTE FOR MADDER.

At the late meeting of the British Association, the President, in his inaugural address, remarked :—

"I may be permitted to refer to one or two discoveries which are exceedingly curious, and some of which may prove of considerable practical importance. The turaco, or plantain-eater, of the Cape of Good Hope, is celebrated for its beautiful plumage. A portion of the wings is of a fine red colour. This red colouring matter has been investigated by Professor Church, who finds it to contain nearly six per cent. of copper, which cannot be distinguished by the ordinary tests, nor removed from the colouring matter without destroying it. The colouring matter is in fact a natural organic compound, of which copper is one of the essential constituents. Traces of this metal had previously been found in animals—for example, in oysters, to the cost of those who partook of them. But in these cases the presence of copper was merely accidental. Thus oysters that lived near the mouths of streams which came down from copper-mines assimilated a portion of the copper salt, without its apparently doing them either good or harm; but in the turaco the existence of the red colouring matter which belongs to its normal plumage is dependent upon copper, which, obtained in minute quantities with the food, is stored up in this strange manner in the system of the animal. Thus in the very same feather, partly red and partly black, copper was found in abundance in the red parts, but none, or only

the merest trace, in the black. This example warns us against taking too utilitarian a view of the plan of creation Here we have a chemical substance elaborated which is perfectly unique in its nature, and contains a metal the salts of which are ordinarily regarded as poisonous to animals; and the sole purpose to which, so far as we know, it is subservient in the animal economy is one of pure decoration. Thus, a pair of the birds which were kept in captivity lost their fine red colour in the course of a few days, in consequence of washing in the water which was left them to drink, the red colouring matter, which is soluble in water, being thus washed out; but, except as to the loss of their beauty, it does not appear that the birds were the worse for it.

"A large part of the calicoes which are produced in this country in such enormous quantities are sent out into the market in the printed form. Although other substances are employed, the place which madder occupies among dye stuffs with the calico-printer is compared by Mr. Schunck to that which iron occupies among metals with the engineer. It appears from the public returns that upwards of 10,000 tons of madder are imported annually into the United Kingdom. The colours which madder yields to mordanted cloth are due to two substances, alizarine and purpurine, derived from the root. Of these, alizarine is deemed the more important, as producing faster colours and yielding finer violets. In studying the transformations of alizarine under the action of chemical re-agents, MM. Graebe and Liebermann were led to connect it with anthracine, one of the coal-tar series of bodies, and to devise a mode of forming it artificially. The discovery is still too recent to allow us to judge of the cost with which it can be obtained by artificial formation, which must decide the question of its commercial employment. But, assuming it to be thus obtained at a sufficiently cheap rate, what a remarkable example does the discovery afford of the way in which the philosopher, quietly working in his laboratory, may obtain results which revolutionise the industry of nations! To the calico-printer, indeed, it may make no very important difference whether he continues to use madder or replaces it by the artificial substance; but what a sweeping change is made in the madder-growing interest! What hundreds of acres, hitherto employed in madder cultivation, are set free for the production of human food or of some other substance useful to man! Such changes can hardly be made without temporary inconvenience to those who are interested in the branches of industry affected; but we must not, on that account, attempt to stay the progress of discovery, which is conducive to the general weal."

RED DYES.

The irritation of the skin produced by red socks and stockings has been traced to a dye known as Coralline, and prepared from carbolic acid. There are very wonderful stories told of the effects

of this dye, both in this country and in France, but it seems that they must be received with some doubt. M. Landrin states that he has made numerous experiments with the substance on animals and on himself, applying it externally and internally, and has found it to produce no effects whatever. M. Chevreul also told of a dyer who dyed his arm with coralline, and suffered no unpleasant consequences from it. It is very difficult to arrive at the truth in matters of this kind. The skins of different people differ greatly in sensibility, and what produces no effect on one person will excite the greatest irritation in another—*Mechanics' Magazine.*

The following evidence upon this question has also been adduced in France:—M. Tardieu has described to the French Academy the results of some further experience of the effects of the Dyes. A young man was brought to him suffering from pustular eruptions in the feet, which were traced to the use of silk stockings of a red colour dyed with coralline. This substance is derived from rosolic acid by oxydising phenic acid, and its action upon the human body is similar to that of croton oil.

NEWEST ARTIFICIAL COLOURING MATTERS.

Mr. W. H. Perkin has given to the Royal Institution a discourse on this interesting inquiry, copiously illustrated by experiments and brilliant specimens of the colouring matters and dyed fabrics. In his introductory remarks he alluded to coal-tar as an oily fluid formed by the destructive distillation of coal, and originally a great nuisance to the gas manufacturer; and referred to a diagram containing a list of forty-nine substances which have been separated from it, among which is aniline. He then referred to the discovery of this substance in indigo by Unverdorben, 1826; its subsequent discovery in the distillation of coal by Runge; and its production from nitro-benzole by Zizin. While endeavouring to convert this artificial base aniline into the natural alkaloid quinine, Mr. Perkin obtained a perfectly black product, which, when purified, dried, and digested with spirits of wine, gave the celebrated mauve dye, in 1856. As indigo was too expensive a material to deal with, and the purification of the aniline obtained from coal-tar a very difficult process, recourse was had to nitro-benzole, produced by the action of pouring nitric acid or aquafortis upon benzole, a hydro-carbon, a product of coal, discovered by Faraday in 1825. The process of the manufacture of this nitro-benzole, and its conversion into aniline when treated with iron and acetic acid, by the influence of hydrogen gas in the nascent state, was described and illustrated. The chemical history of mauveine (the base of aniline purple or mauve) was next given, and it was shown how a fine blue could be obtained by the agency of chloride of lime and a salt of aniline. Mr. Perkin then proceeded to describe the production of the beautiful dye magenta, or aniline red, by the mix-

ture of aniline and toluidine, another coal-tar product. Magenta was observed first by Natanson, in 1856, and afterwards by Hofmann, in 1858, but first made industrially by M. Virguin, whose process was carried out by Messrs. Renard, of Lyons, in 1859. The commercial magenta (brilliant crystals of a beautiful golden green metallic appearance) was profoundly studied by Hofmann, and found to consist of an organic base, which he named rosaniline, and this has become the raw material of a great number of colouring matters, among which the brilliant Hofmann and Britannia violets are specially remarkable. Mr. Perkin next proceeded to consider the production of green colouring matters derived from magenta. By the action of aldehyd upon a solution of rosaniline an unstable blue was produced by Lauth, and this, by the addition of hyposulphate of soda, by Chirpin, a dyer, was converted into the brilliant and durable aldehyd green. This was followed by the iodine green formed in the preparation of Hofmann violets, and the Perkin green somewhat resembling it. Mr. Perkin then alluded to the recent production of colouring matters, such as alizarine, closely resembling those obtained from madder, so that even these natural dyes may now be considered coal-tar colours. Thus, in the short space of thirteen years, a great manufacture has been created now worth more than a million and a quarter pounds sterling; the practical fruits of theoretical chemistry studied simply for its own sake. Among other striking illustrations was the exhibition of the property of fluorescence possessed by certain colouring matters, and of a spectrum entirely formed of coal-tar colours.

PRODUCING COLOURS FROM NAPHTHALINE.

SOME improvements in the production of colour from Naphthaline have been made by Drs. Darmstadter and Wichelhan, of Berlin. The invention, which has been patented in England, consists in acting upon naphthaline with concentrated sulphuric acid, so as to obtain sulpho-naphthalic acid. Sulpho-naphthalic acid, or salts of the same, is then to be subjected to the action of an alkali, such as caustic soda or potash, at a high temperature, and from the resulting product, by the addition of an acid, such as sulphuric acid, naphthylic alcohol is obtained. The naphthylic alcohol obtained either by this or by other methods is submitted to the action of sulphuric and nitric acids, so as to transform it into dinitro-naphthylic alcohol, which product may be employed for the purposes of dyeing and printing.

About one part by weight of naphthaline is taken, and about one part by weight of concentrated sulphuric acid, and they are heated together at a temperature of about 100 deg. centigrade, until the greater proportion of the naphthaline has been converted into sulpho-naphthalic acid. This product is then to be dissolved in water, and the solution saturated with an alkali. The salts of sulpho-naphthalic acid thus obtained are evaporated

to dryness, and are fused with an alkali, such as caustic potash or soda, or with mixtures of the same, so as to obtain compounds of naphthalic alcohol, which upon the addition of dilute acid to the aqueous solution the naphthylic alcohol or naphthol is precipitated, and may be obtained in a crystalline form. The before-mentioned naphthylic alcohol or naphthol so prepared, or obtained from any other source, is to be dissolved in about an equal weight of strong sulphuric acid, and the solution is then gradually added to nitric acid diluted with water, the temperature of which mixture has been previously slightly elevated. The solution passes through different tints, but finally assumes a yellow colour, and the yellow colouring matter crystallises out of the solution on cooling. This substance has been called dinitro-napthylic alcoholic or dinitro-naphthol. The colouring matter thus obtained is to be freed from any adhering solution, and is then ready for use. Should it be necessary to subject the colouring matter to a process of purification it may be purified by solution in an alkali, ammonia for example, and be precipitated therefrom by means of muriate of ammonia or otherwise. When this colouring matter is to be employed for the purposes of dyeing or printing it may first be dissolved in a solvent, such as alcohol, or it may be dissolved in an alkaline solution. The pure substance, or its soluble salts, may either be employed alone or in conjunction with other colouring matters for the purposes of dyeing and printing.—*Mechanics' Magazine.*

PRUSSIAN BLUE AND INDIGO.

A test for distinguishing a Prussian blue from Indigo and Aniline Blues is given by M. Nickles. Fluoride of potassium, he tells us, will discharge the Prussian blue colour, and not affect the indigo or aniline colour. The information may prove of use to calico printers. Ordinary writing ink, it seems, is also decolourised by fluoride of potassium. Whether it has much effect on the paper we are not told.

NEW MANURE.—CANCERINE.

An artificial manure called "Cancerine" is being made in America by drying and grinding up the bodies of a species of crab found in enormous quantities in Delaware Bay. The eggs of this species of crab are deposited on the shore in such quantities that it is said they may be shovelled up by the waggon-load, and large quantities are collected to feed chickens, while the crabs themselves are collected to feed hogs. About 750,000, it is estimated, have been taken every week on about half-a-mile of coast.

BENZOLE.

The demand for Benzole has created a general desire to increase the yield. At present, the only available source is coal-

tar. But it is known that much benzole vapour remains uncondensed, and passes on with the gas, and experiments, we read, have been made with the idea of securing this quantity. In Germany, it would seem they have tried scrubbing the raw gas with the heavier tar oils with much success. The benzole is said to be taken out of the gas by this means, and is afterwards separated, as usual, by fractional distillation. The results are vaguely stated, and we can give no opinion on the process which does not look to us promising, although it is said to yield immense quantities of benzole. The experiments of M. Berthelot point to a not distant day in which the heavier oils will be easily transformed into benzole in any quantity. He has already succeeded in effecting the transformation on a small scale, and his most recent researches seem to show that it may be done on a manufacturing scale. It is hardly necessary to say that if all benzole vapour be removed from gas, the illuminating power will be very considerably diminished.

NEW SUBSTANCE FROM THE WALNUT.

DR. T. L. PHIPSON has ascertained that between the shell and the kernel of the Walnut there exists a thin membrane called the episperm. From this membrane Dr. Phipson has extracted a substance which he calls *Nucitannic acid*, the most remarkable property of which is that when boiled with dilute hydrochloric acid it splits up into glucose, and another new substance called *Rothic acid*.

NEW BASE FROM MORPHIA.

AN example of the way in which practical applications unexpectedly turn up when science is pursued for its own sake is afforded by a result recently obtained by Dr. Matthiessen in his investigation of the constitution of the opium bases. He found that by the action of hydrochloric acid on Morphia a new base was produced, which as to composition differed from the former merely by the removal of one equivalent of water. But the physiological action of the new base was utterly different from that of the original one. While morphia is a powerful narcotic, the use of which is apt to be followed by subsequent depression, the new base was found to be free from narcotic properties, but to be a powerful emetic, the action of which was unattended by injurious after-effects. It seems likely to become a valuable remedial agent.—*Proceedings of the British Association.*

REFRIGERANT SALTS.

EXPERIMENTS have been made by Herr Rudorff to test the Refrigerating powers of certain Salts, and the two most remarkable appear to be the sulpho-cyanides of ammonium and potassium. Of the former 133 parts added to 100 parts of water

reduced the temperature from 12 deg. centigrade to 18 deg. below zero; and of the latter 150 parts added to 100 of water reduced the temperature from 11 deg. centigrade to about 24 deg. below zero. The salts should be in a fine powder, and be stirred into the water by a glass rod, and the water should be contained in a thin glass vessel surrounded by loose cotton.

DECOMPOSITION OF SULPHURETS.

M. Grandidier, of Paris, has invented a method of Decomposing the Sulphurets to be found in iron and coal by subjecting them to the action of steam in a close vessel, the pressure of the steam not being less than 30 lb. per square inch.

SULPHATE OF AMMONIA.

Among the mineral substances much in request for agricultural purposes is Sulphate of Ammonia, of which it may be said that it would be more used if it were more abundant. The existence, therefore, of a natural supply cannot fail to be important; and Prof. G. Ville, of the Jardin des Plantes, Paris, has given a fresh value to the services he has so long rendered to agricultural science by proving that sulphate of ammonia exists in considerable quantities in the lakes (*lagoni*) of Tuscany. These lakes, with distinctive names, are in the province of Volterra, and for some years past have been laid under contribution by wholesale chemists for the boric acid contained in the waters. Prof. Ville, operating on the spot, now finds that in the water of one of the lakes there is 48 per cent. of sulphate of ammonia; in another the quantity is less than 2 per cent.; and it is found also in the vapours which are constantly rising from crevices in the earth. Here, then, is an additional source of enterprise and wealth opened to Italy, which, if properly managed, will materially benefit the agriculture of Europe. It is impossible to foresee an end to the demand for boric acid and sulphate of ammonia. —*Athenæum.*

WASHING PRECIPITATES.

Professor Bunsen, of Heidelberg, has published a paper on the Washing of Precipitates. Every one acquainted with practical chemistry knows how much time is often lost in waiting for a liquid to pass through a filter. Bunsen found the rate of filtration nearly proportional to the difference between the pressures on the upper and lower surfaces of the liquid. If, accordingly, the funnel be fixed air-tight by means of a perforated cork to the neck of a bottle, and the air exhausted in the bottle, the liquid will run faster through the filter in proportion to the diminution of the pressure in the bottle. Comparative experiments, some made according to the old, and others made according to the new

method, showed that the filtration, washing, and drying of a precipitate, which took seven hours by the old plan, could be performed by filtration into an exhausted bottle in thirteen minutes. But a saving of time is not the only advantage of the improved method of collecting and washing precipitates. A more perfect washing, with less water than is required by the common way of proceeding, is by no means the least recommendation of Bunsen's ingenious method.

PHOSPHATE IN WHEAT-SEED.

PROFESSOR CRACE CALVERT states that the result of various experiments he has made is that 100 parts of cotton-fibre yield, when repeatedly washed with water, a quantity of acid phosphate of magnesia. Both husks and seeds also yield certain proportions, and these results show that the phosphates exist in much larger quantity in the seed than in the other parts of the pod. Experiments upon wheat-flour of various kinds showed that whilst the flour contains only a trace of phosphates, especially soluble ones, the bran contains a large quantity. These facts tend to prove that the phosphates and the mineral matters contained in wheat are not combined with the organic matter, but are in a free condition. Other investigations go to prove that although habit and pride have gradually led us to prefer white bread to brown, yet this is an error when we consider the nutritious properties of wheat, especially as food for children, phosphates being essential for the formation of bone and blood.

SILK-DRESSING PROCESS.

DYERS have been in the habit of removing the gum from the surface of raw silk by boiling with soap. A French patent makes known the fact that the end is more easily and cheaply obtained by the use of ammonia. To a kilogramme of silk they use ten litres of water and from 250 to 500 grains of ammonia, according as the silk is white or yellow and hard. The silk is kept in the solution heated to 80 deg. or 90 deg. C. for an hour, and then it is boiled for half an hour. By this treatment silk loses from 22 to 28 per cent. of weight. To finish the process it must be rinsed in a boiling bath containing 1 or 2 per cent. of soap, which bath may be used many times over. The carbonate may be used in place of liquid ammonia.—*Mechanics' Magazine.*

NEW USE FOR GLYCERINE.

IT is proposed to improve Wine by adding to it Glycerine, which is a natural product of the fermentation of grape-sugar, and is present, though in extremely small amount, in all natural wines. But Herr Kolb proposes to add from 1 to 3 per cent., which he says will reduce to the smallest possible limits the

tendency to change which all wines, from their inner nature, possess. It is hardly necessary to say that the author of this suggestion directs perfectly pure glycerine to be employed. In the *Mechanics' Magazine* it is shrewdly remarked: "Certainly that disagreeable smelling, acrid-tasting article commonly sold is not likely to improve the flavour of a wine, or assist in producing a fruity port. Glycerine is said to be largely used by the compounders of artificial champagne, and also by liqueur makers."

BLEACHING IVORY.

A PROCESS for Bleaching Ivory is given by Dr. Artus. He specially mentions the application to ivory plates for pianoforte keys; but it will of course be applicable to all articles of the material, which is so liable to acquire a disagreeable dark colour. The articles are first to be soaked in a solution of carbonate of soda (half a pound of the crystals to two pounds of water) for a couple of days. They are then to be well rinsed with clean water, and afterwards transferred to a solution of three-quarters of a pound of sulphate of soda in two pounds of water, in which they must remain for five or six hours. Then, without removing the ivory, a mixture of one ounce of hydrochloric acid and four ounces of water is to be added, the whole is to be stirred together, and the vessel covered up and left for thirty-six hours. At the end of this time the solution is poured off, and the ivory is to be well washed with water. If it should not have the desired whiteness, the process may be repeated. The proportions of solutions we have given above will suffice to bleach a pound of ivory.—*Mechanics' Magazine.*

IMPROVED BREAD.

A VERY important paper has been published by Professor Liebig on the Improvement of the nourishing qualities of Bread. Certain quantities of phosphates and other salts form necessary ingredients of wholesome food. Now, it is well known that most of these salts, which naturally exist in wheat, remain with the husk. Liebig proposes to add salts, of a nature similar to those remaining in the husk, to the flour, and at the same time to substitute for the carbonic acid developed by fermentation gas liberated from sodic carbonate. The bread prepared according to Liebig's recommendation is said to be of excellent quality, and to exceed in value bread made by the ordinary method.

PROGRESS OF GUN-COTTON.—TRI-NITRO-CELLULOSE.

A VERY able paper on this subject appeared in the *Times*, January 28, 1869. It details the history of the discovery, from Professor Schönbein's *find* at Basle, to Mr. Abel's researches culminating in his "Tri-nitro-cellulose (or safety gun-cotton),

which is now manufactured by Messrs. Prentice, at Stowmarket. The process is thus described: The Austrian manufacture stopped at the point where the cotton was supplied in the form of skeins, which were dipped in a mixture of nitric and sulphuric acid, then placed in jars to soak thoroughly, then half dried in a centrifugal apparatus, and afterwards washed thoroughly and long by hand and in running streams until no free acid could be detected. For small arms cartridges a hollow plaited rope was then made of it, cut into lengths, and arranged round little wooden spindles, the ends of which penetrated the bases of their bullets and held fast there. When first Messrs. Prentice commenced their manufacture they were under the advice of Baron von Lenk, and followed the Austrian method exactly. Soon they found the rope plait was inconveniently long. They tried a solid rope, but it inflamed too suddenly and strained the gun. Then they tried a solid rope of mixed gun-cotton and common cotton. This was not so dangerous, but its action was not always the same. They tried also what may be called gun blotting-paper, and rolled it up into cylinders for cartridges, but they have now exclusively adopted Mr. Abel's newer methods, which have the two advantages of rendering the gun-cotton perfectly safe and almost perfectly manageable, because the great thing to be avoided is a mass of cotton either imperfectly converted or containing free acid. Cotton, like hair in its ordinary state, is made up of a vast number of small tubes, which all have the power of taking in liquid by capillary attraction, and retaining it in spite of all washing. If there is any free acid in the gun-cotton it has many opportunities for combining chemically with other substances, and so setting up heat, which accumulates, and may at last fire a portion of the mass. Mr. Abel obviates this by tearing the cotton into fragments, making it, in fact, into pulp.

The process of making Gun-cotton at Stowmarket is as follows: Rough waste cotton, no matter how short the fibre, is cleaned thoroughly, dried, and dipped into a mixture of three parts sulphuric acid to one of nitric. If the acids were weak, the cotton would dissolve. With the strong acids used a combination of the nitric acid and cotton ensues, while the sulphuric acid takes up the water left behind by the nitric acid and so keeps the latter always strong. There is a row of small tanks fed with acid through the pipes from a reservoir. Into each of the tanks one pound of cotton is dipped, care being taken to immerse it all completely. It is then taken out and laid upon a grating over the tank to drain, and thoroughly squeezed by iron paddles. Twenty minutes suffice for this operation. The converted cotton now goes into jars, which stand in water to keep them cool, for much heat is developed in the combination. After soaking here for many hours, the cotton is placed in a revolving drum with small holes in its exterior. It whirls rapidly round, and discharges most of the spared acid by its centrifugal force. Then comes a very important process—the washing. First the cotton

is thrown into a fall of water, and a man watches to prevent any of it escaping instantaneous immersion, otherwise the acid and the water would set up an action strong enough to burn some of the cotton, or, at least, damage it. After thorough washing in a tank under the waterfall, the material is placed in a vat to steep in water for 24 hours; then it goes to a second and a third, and so on for a week. By this time no acid is perceptible. The cotton is then placed in a mill like that used in paper-making. The water used to make the pulp is slightly alkaline, in order to take up the last traces of acid. The next operation is drying again in a centrifugal machine. There has now been produced a gun-cotton pulp, which has only to be pressed into the shapes most convenient for its intended purpose. The most common forms are those intended for fowling-pieces and blasting. Another invention has lately been introduced to render the cartridges impervious to damp. There are 30 grains of cotton to a gun of No. 12 bore. One grain of india-rubber dissolved in 30 grains of spirit is then used to saturate the pressed gun-cotton. After drying, the spirit evaporates, and the caoutchouc remains throughout the mass, completely preserving every particle from damp, though gun-cotton does not deteriorate by damp so long as it be dried again before firing. Almost everything that is made of gun-cotton has a hole through it to facilitate combustion. The pulp is first pressed in a very wet state, and then pressed yet smaller before drying. It is finally dried, and put in boxes for use. The pulp and various shapes into which it is pressed are Mr. Abel's inventions.

Such is the manufacture of Gun-cotton. Some of its properties are most curious, and really deserve to be called sympathetic. For instance,—take a loosely-twisted thread of gun-cotton, and lay it on a flat table, carefully drawing out a few filaments at one end, so as to form a point. Light a small piece of wood, a match if you will, but blow it out as soon as the wood is well inflamed. Approach the spark that remains delicately to the extended filaments They meet it and begin to burn. But how? Very far from explosively. The whole thread smoulders away like touch-paper so long as no wind blows upon it. But blow the flame the least towards the rest of the thread, or even bring a flat surface close to it so as to push the heated gas for one moment back upon the thread, and the whole goes off in one flash in the ordinary way. Light it with the flame of a match, the whole flashes off at once. Go one step farther and ignite it by a little detonating arrangement, the gun-cotton sympathizes again and actually detonates. Since this curious property was discovered, it has been found to apply to gunpowder in a more limited form; and here have we not the long-sought clue to the sympathetic explosion of one magazine after another even when at considerable distances apart? Neither a layer of air, nor water, nor even plaster of Paris, will save gun-cotton from detonating if there be an explosion of the same character

near it. Here is a strange physical property which will be of the utmost value in mining. It is the sudden and violent effect of nitro-glycerine without its character of treachery to its friends. The miner has in his charge of gun-cotton two perfectly different physical forces stored up. He can call either of them into life at his will. Let him light his piece of prepared rope with any ordinary flame, even the explosion of gunpowder—the gun-cotton will give just such a rending strain as gunpowder gives—rather more rapid, but of the same nature. Place a small detonating tube inside your rope, or leaning against it, ignite this, and the gun-cotton will explode with the same rapid, active, intensely local explosion, shattering to atoms all that is within reach. The smouldering form of burning is as yet too delicate to be made practical use of. The mildly explosive form is adapted for guns, the rapid shattering force for any purpose where great local effect is to be produced, such as shattering rocks into small pieces, charges for shells, blowing down palisades, and generally breaking anything into pieces.

The President of the British Association, in his Inaugural Address at Exeter, remarked: "To show the willingness of Government, when practicable, to carry out the suggestions of the association, at the Cambridge meeting in 1862 a Committee was appointed for the purpose of investigating the application of Gun-cotton to warlike purposes. At the Newcastle meeting, in the following year, this committee presented its Report, and a resolution was passed, recommending the appointment of a Royal Commission. This recommendation was adopted, and in 1864 a Commission was appointed, which was requested to report on the application of gun-cotton to civil as well as to naval and military purposes The committee gave in its Report last year, and that Report, together with a more recent return relative to the application of gun-cotton to mining and quarrying operations, has been printed for the House of Commons.

"A substance of such comparatively recent introduction (the President continued) cannot be fairly compared with an explosive in the use of which we have the experience of centuries. Yet, even with our present experience, there are some purposes for which gun-cotton can advantageously replace gunpowder, while its manufacture and storage can be effected with comparative safety, since it is in a wet state during the process of manufacture, and is not at all injured by being kept permanently in water, but merely requires to be dried for use. Even should it be required to store it in the dry state, it is doubtful whether, with the precautions indicated by the chemical investigations of Mr. Abel, any greater risk is incurred than in the case of gunpowder. In the blasting of hard rocks it is found to be highly efficient, while the remarkable results recently obtained by Mr. Abel leave no doubt of its value for explosions, such as are frequently required in warfare. General Hay speaks highly of the promise of its value for small arms; but many more experiments

are required, especially as a change in the arm and mode of ignition require a change in the construction of the cartridge. In heavy ordnance, the due control of the rapidity of combustion of the substance is a matter of greater difficulty; and though considerable progress has been made, much remains to be done before the three conditions—of safety to the gun, high velocity of projection, and uniformity of result, are satisfactorily combined."

PHOTOGRAPHY IN WAR.

Mr. H. Baden Pritchard, of the General Photographic Establishment of the War Department, has read to the United Service Institution a paper on the Application of Photography to Military Purposes. The author stated that the first time photography was used in connection with military matters was during the Crimean War, when Lord Panmure, then Secretary of State for War, conceived the idea of securing some photographic records of the campaign. At the time they were produced the art was still in its infancy, and many of the manipulations exercised were of an experimental character. Since that time photography has progressed to a wonderful degree, and the necessity of diffusing a knowledge of the subject has been so fully appreciated by the authorities of the War Department, that a school of instruction has been formed for the special purpose of instructing classes of young soldiers in its details. This school, which forms a portion of the Royal Engineer Establishment at Chatham, is of considerable benefit to the service. During the recent Abyssinian campaign a staff of photographers, instructed and equipped from this establishment, did good service in copying maps and sketches of the route. One of the most important uses to which the process was applied was the copying of maps, plans, designs, and rare MSS., as practised at the Ordnance Survey-office, Southampton. In this establishment the practice of Photo-zincography, the invention of Colonel Sir H. James, R.E., has been carefully elaborated, and has been employed with such unequivocal success, that the Governments of France, Prussia, Austria, Belgium, and America have adopted it with more or less modification. In addition to the multiplication of special maps for warlike purposes, valuable service has been done in the establishment at Southampton by the reproduction of rare and curious MS. facsimiles of the Great and Little Domesday Books, bound up in 35 imperial quarto volumes; and also of the national MS. of England and Scotland, without the necessity of tampering in any way with the originals.

At the general Photographic establishment—a branch of the chemical department at Woolwich, under the direction of Professor Abel, F.R.S., the camera is employed in many ways. All experimental structures, such as shields, guns, small arms, waggons, or rockets are photographed. The results of firing experimentally against iron plates of different thicknesses are

reproduced; pictures for purposes of instruction, showing the method of working guns of different descriptions, and the positions taken up by individual gunners on the issue of various orders are taken; photographs exhibiting the regulation mode of wearing accoutrements, the precise manner in which the harness of horses should be adjusted, the method of packing waggons and fitting service saddles, and the mode in which military tents and equipages are set up are also included in the collection of the institution. Prints from the negatives are issued to various departments of the army, both in England and India. Photography can be usefully and economically employed in the construction and preservations of patterns at Woolwich and other manufacturing stations.

Returning to the subject of the employment of photography in the field, Mr. Pritchard said that the avowed purposes for which the art was used in that case was for reproducing and copying maps and plans, and taking pictures of important localities and interesting objects. In discussing the importance of this part of the system, he said that during the Abyssinian campaign as many as 30 copies were prepared and distributed to brigadiers and others within 24 hours after the original plan of certain places had been sketched. He thought it advisable that copies of field maps intended to be of a lasting character should be printed on linen, cambric, or silk. He recommended that landscape views should be taken, not only on account of the particular interest they possessed as such, but also on account of their value to an army in the field. Sketches of an enemy's position may be obtained at a considerable distance without much risk of danger. Mr. Pritchard himself obtained a picture of a building two miles distant from the camera. The camera may also be used as a theodolite, and the distance between the reconnoitring party and the enemy's position accurately and rapidly determined, supposing the actual dimensions of the enemy's fort or intrenchment to be known. The camera may also be used in the production of landscape pictures to illustrate the ground plan or sketch of route. The progress of works may also be ascertained by means of photographs, and this system of ascertaining the rate at which works were proceeding has been adopted by several firms of contractors.

Referring to the multiplication and printing of military maps and plans in the field by means of photography for distribution among Staff officers, to be of a lasting character such photographs are recommended to be printed upon linen, cambric, and silk, instead of upon paper. Now, although permanence is an essential quality in pictures of this description, still simplicity and rapidity of production are far more important, seeing that large numbers of copies are required in as short a time as possible. By printing upon a densely-woven linen, the advantages secured are very great over those of paper; the fabric prints more quickly, is capable, owing to its open structure, of more rapid and perfect washing (the most important operation in photography), and,

finally, needs no subsequent mounting upon a flexible material, as in the case with paper maps. Thus much economy of manipulation is effected, a matter of some consideration when performing hurried operations in the field.

PROGRESS OF PHOTOGRAPHY.

In a *resumè* of facts and new processes, in the *Mechanics' Magazine*, it is remarked that "nearly all wet and dry plates used in photography permit some of the actinic rays to pass through the film. These rays thus wasted often do a certain amount of positive harm in addition, for the back surface of the glass often reflects them once more upon the film, so as to produce a blurred and indistinct picture. In practice, wet red blotting paper is often placed in optical contact with the back of the glass plate, to prevent this blurring by reflected light. Manifestly, then, the most perfect films are those which absorb nearly all the chemical rays; and as few such films are employed in photography, except in rare instances, when they are obtained by accident, there is plenty of room for experiment in this direction. Plenty of yellow iodide of silver in the film is chemically more opaque than plenty of bromide of silver, and this is another reason why photographers should once more give iodized collodion a trial. In dry plates, the use of deeply coloured organifiers well deserves a trial.

Having obtained a film which utilises all the mechanical power of the chemical waves of light, it is desirable that every part of the sensitive surface should come into immediate contact with the developer when it is applied. When bromide of silver is held in suspension in a very weak solution of gelatine, and some of this solution is allowed to dry upon an accurately levelled glass plate, a rough film results, held to the plate only by a mere trace of gelatine. Such a film gives an intense picture very rapidly when an alkaline developer is applied. But if the bromide of silver be held in suspension by a very strong solution of gelatine, and the same experiment tried, no picture whatever can be developed; in fact, the particles of bromide of silver might as well have been embedded in the solid glass of the plate. Again, a wet sensitized collodion plate develops readily, but the same plate dried requires longer exposure and tedious development. Wet collodion films are soft and pulpy, but when once they have been dried they form a tough skin, and never return to their former state. Hardwich has pointed out that iodide of silver is much more sensitive to light in the interstices of wet collodion than in the interstices of wet paper or other medium, and he attributes this sensitiveness to the loose state of cohesion in which it is held in wet collodion. It is easy, therefore, to see that a tough sample of collodion may allow development to proceed more rapidly on the upper surface of the film than on the surface in contact with the glass. There is, in fact, ocular

evidence that chemical action proceeds with unequal velocity at the two surfaces of collodion films, because pictures which appear to have been quite fixed by cyanide of potassium, when viewed from the one side, are often seen not to be fixed when viewed through the glass from the other side. When a developer does not at once penetrate the film, a picture of low intensity is probably the result. This reasoning points to the conclusion that the best collodion films should let no actinic rays pass through them, and should be of a soft and spongy, and not tough consistency. Other qualities, well known to photographers, are likewise necessary in good collodion. There is plenty of room for experiment in this direction by some good photographer versed in the manufacture of collodion, who should keep these principles in view, and ascertain the nature of the structure of the film given after sensitizing, by each of his samples of collodion, the microscope being the medium of examination. Very probably, in the best dry plate processes of the future, collodion will be entirely abolished; at all events, a layer of dry bromide of silver, containing a trace of organic matter, and not imbedded in a collodion or any other skinny film, gives a picture which comes out under the alkaline developer with marvellous facility.

The Coffee process is rising rapidly in favour during the past few months. The formulæ are as follows:—A large tea-spoonful of roasted ground coffee of good quality is put in a teacup about two-thirds full of boiling water. After standing for about ten minutes, the infusion is filtered, and a piece of sugar about the size of a pea is added to it. This is the preservative solution. The plate is coated with rather old and red collodion, and sensitized in a somewhat acid bath. Next, it is washed thoroughly, the preservative is applied in two doses, and, lastly the plate is dried by dark heat. A full exposure in the camera is desirable. The picture is developed by first bringing out a phantom image by the application of a two-grain solution of plain pyrogallic acid without silver or citric acid, after which the intensification is performed by the addition to the pyrogallic acid of one or two drops of a solution containing about twenty grains each of nitrate of silver and citric acid to the ounce of water. The films have a tendency in this process to slip off the glass, but this evil is averted by running a little dilute albumen round the edge of the plate before coating with collodion. By employing alkaline development, the exposure is very much reduced.

In Mr. Sutton's new Alkaline wet process all the chemicals and baths are alkaline and neutral, and the alkaline plates thus produced are used wet, with twice the rapidity of the best wet free nitrate plates. If the process possesses all the advantages claimed by the inventor, it will be of the greatest value in instantaneous photography, but in no other branch is it likely to compete with the ordinary wet process. If the process is so much more rapid than the wet one, he is able to take pictures of street

scenes and moving figures and vehicles with much more rapidity than anybody has done yet. If the process has all the rapidity stated, the street views taken instantaneously by Blanchard and others will be thrown into the shade.

The Ethnological Society, under the Presidency of Professor Huxley, is arranging to take photographs of specimens of all races of men in all parts of the globe. Such photographs should be taken before a background, ruled off by plainly visible lines into spaces six inches square, so that all the pictures should show the dimensions of the individual photographed, and be directly comparable. The person should stand upright, and be in contrast with the background. If printed on paper by the ordinary silver process, they are apt to fade away. It is better that the negatives should all be sent to England, and be copied by a permanent carbon process, or upon collodion films, cemented between two plates of glass with tough Canada balsam.

A process of photographic printing has been propounded by M. Albert, of Munich, in which a thick plate of glass is coated with a layer of albumen, gelatine, and bichromate of potash, which is then rendered insoluble by exposure to light. On the prepared surface a similar solution is poured without exposure, and while still sensitive it is exposed to light under a negative, after which it is washed and treated as a lithographic stone. The photo-lithographs of M. Pouncey, however, are procured from the stone itself.

A new method of obtaining photographic engravings has been introduced. The photographic image is first impressed upon a sensitized sheet of gelatine, which is then dipped in a solution of alum, and when dry and hard the gelatine film is pressed down with great force upon a steel plate, and leaves an indentation of the photographic picture in the steel which may be printed from in the manner of common steel engravings. There are now several methods of obtaining excellent impressions from photographic images engraved both on steel and on stone, of which the method of M. Garnier has heretofore been the best in the case of steel plates, and that of Mr. Pouncey, of Dorchester, is the best in the case of photographs. M. Garnier is the inventor of the method now widely practised of facing copper plates with steel by the electrotype process, whereby the number of impressions from them is indefinitely increased.—*Illustrated London News.*

THE PHENOMENA OF LIFE.

We quote the following from the Presidential Address of Prof. Stokes, at the late Meeting of the British Association:—"With reference to those branches of science in which we are more or less concerned with the Phenomena of Life, my own studies give me no right to address you. I regret this the less because my predecessor and my probable successor in the presidential chair are both of well-known eminence in this department. But I hope I may be permitted as a physicist, and

viewing the question from the physical side, to express to you my views as to the relation which the physical bear to the biological sciences. No other physical science has been brought to such perfection as mechanics; and in mechanics we have long been familiar with the idea of the perfect generality of its laws, of their applicability to bodies organic as well as inorganic, living as well as dead. Thus in a railway collision, when a train is suddenly arrested the passengers are thrown forward, by virtue of the inertia of their bodies, precisely according to the laws which regulate the motion of dead matter. So trite has the idea become that the reference to it may seem childish. But from mechanics let us pass on to chemistry, and the case will be found by no means so clear.

"When chemists ceased to be content with the mere ultimate analysis of organic substances, and set themselves to study their proximate constituents, a great number of definite chemical compounds were obtained which could not be formed artificially. I do not know what may have been the usual opinion at that time among chemists as to their mode of formation. Probably it may have been imagined that chemical affinities were, indeed, concerned in their formation, but controlled and modified by an assumed vital force. But as the science progressed, many of these organic substances were formed artificially; in some cases from other and perfectly distinct organic substances, in other cases actually from their elements. This statement must indeed be accepted with one qualification. It was stated several years ago by M. Pasteur, and I believe the statement still remains true, that no substance the solution of which possesses the property of rotating the plane of polarisation of polarised light had been formed artificially from substances not possessing that property. Now, several of the natural substances which are deemed to have been produced artificially are active, in the sense of rotating the plane of polarisation; and therefore in these cases the inactive, artificial substances cannot be absolutely identical with the natural ones. But the inactivity of the artificial substance is readily explained on the supposition that the artificial substance bears to the natural the same relation as racemic acid bears to tartaric—that it is, so to speak, a mixture of the natural substance with its image in a mirror. And when we remember by what a peculiar and troublesome process M. Pasteur succeeded in separating racemic acid into the right-handed and left-handed tartaric acids, it will be at once understood how easily the fact, if it be a fact, of the existence in the natural substance of a mixture of two substances, one right-handed and the other left-handed, but otherwise identical, may have escaped detection. This is a curious point, to the clearing up of which it is desirable that chemists should direct their attention.

"Waiving, then, the difference of activity or inactivity, which, as we have seen, admits of a simple physical explanation, though the correctness of that explanation remains to be investigated,

we may say that at the present time a considerable number of what used to be regarded as essentially naturally organic substances have been formed in the laboratory. That being the case, it seems most reasonable to suppose that in the plant or animal from which those organic substances were obtained they were formed by the play of ordinary chemical affinity, not necessarily nor probably by the same series of reactions by which they were formed in the laboratory, where a high temperature is commonly employed, but still by chemical reactions of some kind, under the agency in many cases of light, an agency sometimes employed by the chemist in his laboratory. And since the boundary line between the natural substances which have, and those which have not, been formed artificially is one which so far as we know simply depends upon the amount of our knowledge, and is continually changing as new processes are discovered, we are led to extend the same reasoning to the various chemical substances of which organic structures are made up.

"But do the laws of chemical affinity, to which, as I have endeavoured to infer, living beings, whether vegetable or animal, are in absolute subjection, together with those of capillary attraction, of diffusion, and so forth, account for the formation of an organic structure, as distinguished from the elaboration of the chemical substances of which it is composed? No more, it seems to me, than the laws of motion account for the union of oxygen and hydrogen to form water, though the ponderable matter so uniting is subject to the laws of motion during the act of union just as well as before and after. In the various processes of crystallisation, of precipitation, and so forth, which we witness in dead matter, I cannot see the faintest shadow of an approach to the formation of an organic structure, still less to the wonderful series of changes which are concerned in the growth and perpetuation of even the lowest plant."

"THE SCIENTIFIC MYSTERY."

An extraordinary little instrument, bearing the above title, has been issued by the London Stereoscopic Company, of Cheapside and Regent Street. It consists of a box containing several opaque cases. A stranger can secretly place a series of numbers, words, or portraits, or ask a series of questions in any order he pleases; when he has done so, he slips them into one of the opaque cases and requests the possessor of the instrument to inform him what he has done. The person thus appealed to applies a slight tube, containing the head of a magician, to the outside of the case, and in a few moments it correctly reveals what is inside, but which is unseen by any human eye. The mode of operation is very simple, but *how* the magician's head reveals the hidden question is indeed a mystery which inquirers must endeavour to solve for themselves. It forms part of a guinea box of several other interesting Christmas novelties, but we believe, it is to be had separately.

Natural History.

ZOOLOGY.

"CLOSE TIME," FOR THE PROTECTION OF INDIGENOUS ANIMALS.

There has been presented to the British Association a Report drawn up by Mr. H. E. Dresser, of the Committee appointed to consider the expediency and practicability of establishing a "Close Time," for the Protection of Indigenous Animals. The report commences by a reference to the recent legislation for the protection of sea-birds, and approves it, on the grounds that such birds are useful in destroying grubs and worms, in acting as scavengers in the harbours, in warning vessels off the rocks during fogs, and in pointing out the localities of shoals of fish. The question chiefly dealt with is, however, whether it will be well to afford protection to most, if not to all, of our birds—at least during the breeding season. The committee are fully convinced of the desirableness of doing so, but observe that the British agriculturist is generally no naturalist, and that he yet remains to be convinced. They refer to the example and experience of foreign countries, as Germany, Sweden, and the grain-growing parts of Russia, where birds that are here killed as vermin are carefully protected, and have nesting-boxes provided for them. In these countries sparrows, starlings, and particularly jackdaws, swarm near most of the villages; and, according to the peasants, are of infinite use in freeing the crops from insects. The report cites much evidence upon this part of the question, and then proceeds to lay down the general principle that the best mode of determining the good or harm done by birds is by studying the nature of their food. The statement of the Rev. D. Tristram that birds of prey, if left unmolested, would have stamped out the grouse disease, is quoted with approval, and it is said, as the result of examination, that the common buzzard, now nearly extinct in these islands, is by no means injurious to game. Its food consists chiefly of frogs, mice, moles, &c., and seldom or never of birds. The kestrel and the merlin feed much in the same manner, and the sparrow-hawk, the only true enemy of the game preserver, has for its favourite quarry the wood-pigeon, which is now increasing to an extent injurious to agriculture. Professor Newton and Dr. Altum have examined a large number of the castings of various species of the owl tribe, and have found in them the remains of an almost incredible number of bats, mice, shrews, moles, beetles, cockchafers, and larvæ of various kinds. Many of the smaller birds are entirely insectivorous, as the woodpecker and the titmouse. The latter feeds largely on the eggs of *Bombyx pini*,

which is so destructive to pine forests. Every female of this butterfly will lay from 600 to 700 eggs, and, but for the tits, they would increase enormously. It has been calculated that a single tit will devour 1,000 insects' eggs in a day. Many birds that are usually insect-eaters do good service by eating the seeds of various weeds, by their occasional large consumption of insects, and by feeding their young on them almost exclusively. Thus the much persecuted sparrow is said to be a good friend to the farmer, and amply to repay him for the corn that he consumes. Herr Wicke, of Gottingen, has examined the stomachs of 118 sparrows, procured between the 21st of April and the 24th of June. Of these 45 were adults and 73 were young, from the small naked nestling to the fully-fledged bird. Three of the adult birds contained grain only; the rest an admixture in various proportions of grain, the seed of weeds, and the remains of beetles and other insects. Among the young, however, insect remains greatly preponderated. The report concludes by an admission that much information with regard to the habitual food of birds is still needed, and with an invitation to naturalists in different localities to assist in the investigation of the subject. The committee even now feel sure that the good done by birds will be found greatly to preponderate over the harm, and that it will be found expedient to afford protection to them during the breeding season. They cite the example of the United States where such protection is now afforded, and where the law is found to work excellently well. The report does not deal with one question that is not of some practical importance, and on which both farmers and gardeners require trustworthy information. It is commonly believed that insect and egg-eating birds do much harm, especially to fruit-trees, by destroying the buds in their search for food. Naturalists should ascertain whether such birds ever attack buds that insects have not attacked previously, and also whether, in the latter case, the bud is already damaged beyond the possibility of receiving further injury. We commend this additional investigation to those who are interested in promoting the objects of the committee.

ANATOMICAL QUESTIONS.

PROFESSOR HUXLEY has read to the Zoological Society a paper on the representative of the *malleus* and *incus* of the Mammalia in other Vertebrata. He reviewed the views put forward by former anatomists on this subject, and particularly alluded to the papers recently written by Prof. Peters on this question, in which was advocated the doctrine of the homology of the *ossicula auditûs* and the tympanic bone of Mammals, with the *columella auris* and the quadrate bone respectively of other Vertebrates. Prof. Huxley entered at length into the reasons which induced him to believe that this doctrine was untenable, it being obvious to him, after a considerable study of the subject, that the *malleus*

belongs essentially to the mandibular arch, and the *incus* to the hyoidean arch; and finally came to the conclusion that the *os quadratum* of the Sauropsida corresponds to the *malleus* of the Mammalia, while the *incus* of the latter is represented in the Sauropsida by a "supra-stapedial" cartilage or ligament.

A communication was read from Mr. G. Gulliver, on the muscular sheath of the cardiac end of the œsophagus of the Aye-Aye (*Cheiromys Madagascariensis*), in which he pointed out that the structure of this organ in the Aye-Aye corresponds with that which prevails in the order Quadrumana, and thus constitutes an additional reason for referring Cheiromys to that order.

DISTINCTION OF GROUPS.

Professor Huxley has communicated to the Geological Society "Further Evidence of the Affinity between the Dinosaurian Reptiles and Birds." The author stated that Hypsilophodon, from the character of its teeth, probably subsisted on hard vegetable food. He was inclined to think that the progress of knowledge tended rather to break down the lines of demarcation between groups supposed to be distinct, than to authorise the creation of fresh divisions.—*Athenæum*.

"WHAT IS BATHYBIUS?"

Professor Williamson, in the *Popular Science Review*, discusses the question of the difference between living and dead matter. Protoplasm is the name that has been given to the albuminous substance such as constitutes the white of an egg, of which living structures are for the most part built up; and, as it constitutes the lowest known manifestation of both animal and vegetable life, it brings us to the boundary which separates the organic from the inorganic world. Protoplasm, it can be shown, is composed of oxygen, hydrogen, nitrogen, and carbon. Nevertheless, out of these elements we are unable to elaborate protoplasm; and although the chemical composition of living and dead matter may be the same, there is a power of assimilation in the living which does not exist in the dead, and this power seems to constitute the chief specific difference between them. We have not yet been able to discover any force which, without the intervention of a living agent, can convert inorganic into living matter. Nevertheless, there is no reason to doubt that at some period or other it must have been so converted, otherwise there would be no visible source of the life which now exists upon the globe. Bathybius is the name given to the vast masses of submarine protoplasm which have been discovered at the bottom of the Atlantic, and which consists of a transparent jelly, containing several different kinds of minute granules, some of which have been identified with those found in the chalk formation. It has since been inferred by some persons that we are still living in

the cretaceous epoch. But from this conclusion Professor Williamson dissents, as the fossil Texillaria present in the chalk is not represented in the Bathybius; so that, even if the present formation of chalk is accounted a continuation of the ancient formation, the two are not identical, as there is some difference in their fossils. The zoological affinities of Bathybius are perplexing. Häckel has separated the Protozoa, under the name of Protista, from plants on the one hand and from animals on the other; so that the Protozoa may be regarded as constituting a third organic kingdom, from which both the others have been derived. Of the known Protozoa, Bathybius must be accounted the lowest in the scale, and by many it is regarded as the living exemplar of the Laurentian Eozoon.—*Illustrated London News.*

THE SIAMESE TWINS

The return to this country of the Siamese twins 38 years after their first appearance here, has naturally excited a good deal of interest and curiosity, both among men of science and the general public. The rumour that has preceded them, to the effect that the bond of their long union might, perhaps, be shortly severed, has added much to this feeling, and has given occasion to some very unnecessary sensational writing upon the subject. For this reason, and also because some of the popular notions about twins have been even exaggerated with regard to them, we think it desirable to place before our readers a short account of the facts of the case.

Chang and Eng, the Siamese twins, were born in May, 1811, so that they are not quite 58 years old. They are of short stature, Eng, the taller of the two, being 5 ft. 2½ in. high, Chang about an inch shorter. They have had excellent health throughout life, and possess good muscular development. The band that unites them sprang originally from the lower portion of each breast bone, and keep them face to face; but their efforts during childhood to attain a more convenient position produced some bending of the yielding structures concerned, so that they can now stand nearly, but not quite, shoulder to shoulder, in which position they usually cross their adjacent arms behind each other's backs. When necessary, however, as at meals, they can bring both arms forward without inconvenience. The band itself is about four inches in length. It is rather more than seven inches in circumference in the centre, and more than three inches deep at its junction with each body. It is unfortunately too thick to be under any circumstances translucent; and all attempts to see by the means of the lime or magnesium light the nature of the contained structures have ended in failure. As far as can be estimated by the touch, the band contains at its upper part the cartilages of the two breast bones, curved round and meeting at its centre, and united by a sort of imperfect joint. To these cartilages are added those of some adjacent ribs, probably of the seventh and eighth. At the

lower part it is quite certain that the general cavity of the abdomen of each brother enters the band; but whether these cavities communicate in the centre cannot be ascertained with certainty. The nerves of each brother pass a little beyond the middle of the band, so that a touch is felt by both over a central portion about an inch in width; but beyond that portion only by the brother that is touched. The blood-vessels of each must in like manner communicate; but there is nothing like interchange of blood between the two, and some experiments have been made which show that chemical agents introduced into one body have no appreciable effect upon the other. The hearts of the two brothers are perfectly distinct, and even somewhat unlike, the pulses of the two at the time of our inspection were a little different in frequency and decidedly so in character. On various occasions they have been extremely different. The respiration of the twins is wholly independent of each other.

It may, therefore, be said broadly that there is no more intimate union between Chang and Eng than such as might be effected artificially between any two persons. They are in every respect two men, with the misfortune of this connecting band. Their mental operations are entirely distinct, of which we can perhaps give no better illustration than by saying that when playing chess against an adversary they consult one another about the next move. Their original resemblance, the necessities of their position, and the fact that their experiences must have been absolutely identical throughout life, have combined to bring them into an extraordinary degree of concord in thought and action, but into no greater degree than may be thus perfectly accounted for. The very question about their separation of itself declares their perfect separateness. It appears to have arisen entirely from the conflicting claims of their respective families, and to be contemplated only as a sacrifice of the fraternal bond to the interest of children. Most probably, however, the idea will not be carried into execution. The surgeons who have as yet been consulted are decidedly opposed to it, and think the danger too great to be incurred for the sake of the doubtful benefit. The connection between their respective blood-vessels is such that they must necessarily have any blood disease in common; and it is probable that the last illness of one, from physical as well as from moral causes, would be the last illness also of the other. The separation would present no surgical difficulty, and might be accomplished at any time if the accidental illness or death of one brother should require it. But, putting accident aside and dealing with constitutional causes, it is most probable that the brothers, loving in their lives, in death will not be divided.

It has plainly been their study, and has become their second nature, to act in harmony with each other in all things. They move as if by one impulse, and without verbal communication, and it is said, indeed, that they rarely talk to each other. But

each would feel the other's impulse to move before a bystander could detect it. They take pleasure in rowing, shooting, fishing, and sports that they can pursue in concord. They take no pleasure in sports that would place them in opposition, as in playing games of chance or skill against each other, although perfectly capable of playing such if they cared for them. We need only add that they appear to be very courteous and intelligent gentlemen; and we are informed that during their long lives in North Carolina they have earned the respect and esteem of their neighbours alike in their business transactions and in their private lives. They were slaveholders, enthusiastic Southerners, and lost largely by the collapse of the South. We trust their visit to Europe may in some degree repair their shattered fortunes, and may afford them the means of returning in tranquillity to their former mode of life.—*Times*, February 11.

UNITED TWINS.

AMONG the most remarkable twins united anteriorly, after the fashion of the Siamese twins, and who have survived after birth, were two girls described by Dr. Berry, who lived to be seven years old. The drawing which he gives of them, and which is reproduced in a lecture by Sir James Y. Simpson, of the University of Edinburgh, in the *British Medical Journal*, shows them to have been healthy, well-looking, and otherwise active. Food taken by the one nourished the other; but they were different in character, and one sometimes woke while the other slept. Of twins who have lived united back to back, the best known instance is that of the two Hungarian sisters, Helen and Judith, who were thus fixed: they were born in 1701, and died at Presburg in 1723, aged twenty-three. Some disorders they had separately; others, as small-pox or measles, together. Judith, always feeble, sank under disease of the head and chest. Helen, who preserved her health well till the last, felt her own strength suddenly fail, though her speech remained entire; and, after a brief death-struggle, she died with her. Sir J. Simpson saw, in 1856, two female children, Amelia and Christina, then five years of age, united exactly as Helen and Judith. They are said to be now living in the Southern States of America. They were born in Colombo county, South Carolina. Although united back to back, and completely fused, they were very different in dispositions and temperaments. When they quarrelled more bitterly than usual, they backed at each other with their elbows, and knocked with their sinciputs. They ran and walked with facility, one backwards and the other forward; and notwithstanding their partial community of body, one was sometimes seen to eat while the other was overpowered with sleep. Sir James Simpson figures and describes, in the *Journal*, other twins, partial and complete; as Rita-Christina, who, between thirty and forty years ago, attracted the deep interest of the medical profession in

Paris; and Lazarus and John Colloredo, born at Genes in 1617, who were twenty-eight years of age when last seen at Basle by Bartholinus. The attached and imperfectly developed twin, John, hangs in the drawing, as in life, head downwards, from the lower part of the chest of Lazarus. Zacchias strongly questions if he had a rational soul and deserved the rite of baptism.

THE CHINESE RACE.

A PAPER has been read to the Ethnological Society by Mr. C. T. Gardner, 'On the Chinese Race; their Language, Government, Social Institutions and Religion.' The leading idea running through this paper is that the Chinese, whilst most tenacious of their ancient forms, have nevertheless been able to adapt these forms to the exigencies of modern society. If the ideographic be regarded as the most ancient form of writing, then the Chinese have preserved, in their present language, a style more ancient than that of any Egyptian hieroglyphics extant; and yet no language possesses a greater power of expressing new ideas, or of coining new words for the purposes of modern science. In theory, the Chinese government is perfectly patriarchal, and yet is found suitable to the rule of a population of four hundred millions! The religion, too, is of the most ancient character; its chief principles being the worship of ancestors and the deification of heroes.

THE CAT-BEAR.

THE first specimen of this remarkable animal, from the elevated region of Thibet, has been brought alive to Europe, and added to the menagerie of the Zoological Society. It is sometimes called the wah, sometimes the panda; Dr. Jerdon gave it the name of the cat-bear. It is the *Ailurus fulgens* of naturalists. Cuvier considered it to be probably the handsomest mammalian quadruped in existence. It is a creature that stands very much *per se*, but, nevertheless, appertains to the ursine family; and perhaps its nearest cousin is the kinkajou (*Cercoleptes candivolvulus*) of Central America, from which, however, it differs in many particulars. Its external form and proportions are more those of a racoon (procyon), with which the size also nearly corresponds. Its fur is dense and somewhat long; the upper parts of the body are of a deep ochreous-red; the head and the tail are paler and somewhat fulvous, but displayed on the tail are dark rings. These caudal rings remind us of the racoon's. The face, chin, and interior of the ears are white; the ears externally, and all the lower surface, with the entire limbs, and also the tail-tip, are of an intense black. From the eye to the gape runs a broad vertical line of ochreous-red blending with the dark lower surface; the moustache bristles are white, and the muzzle is black. The length of the head and body is 22 in.; the length of the tail is 16 in.; the height is about 9 in., and the weight 8 lb. or thereabout.

"This very curious and richly-coloured animal," writes Dr. Jerdon, "is a denizen of the south-eastern Himalayas, having been only taken in Nepaul and Sikhim (to which we may add Bhotan, still further eastward). It is found at elevations from 7,000 feet up to12,000 feet or so. General Hardwicke was the first European to discover this animal, but his description of it was not published till after M. F. Cuvier had described it from a specimen sent to Paris by M. Durancel." Mr. B. H. Hodgson has given a full account of it, from which the following observations are extracted:—

"The wah is a vegetarian climber, breeding and feeding chiefly on the ground, and having its retreat in holes and clefts of rock. It eats fruit, roots, sprouts of bamboo, acorns, &c.; also, it is said, eggs and young birds; also milk and ghee (a preparation of butter), which it is said occasionally to purloin from the villages. These animals feed morning and evening, and sleep much in the day. They are excellent climbers, but on the ground move rather awkwardly and slowly. All their senses appear to be somewhat obtuse, and they are easily captured. In confinement they are placid and inoffensive, docile and silent, and shortly after being taken they may be suffered to go about loose. They prefer rice and milk to all other food, and they are free from any offensive odour. They drink by lapping with the tongue, hiss and spit like cats when angered, and now and then utter a sharp, deep grunt like that of a young bear. The female brings forth two young in spring. This curious animal usually sleeps laid on the side, and rolled into a ball, the head concealed by the bushy tail."

"It is not very common now," remarks Dr. Jerdon, "about Darjeeling. The Lepchas there say that it feeds a good deal on insects and their larvæ, which it scratches out of the ground. A friend of mine watched a pair of them seated high up in a lofty tree. They were making the most unearthly cries, he assured me, that he had ever heard. It was evidently the pairing season." The female has eight mammæ, though stated to produce only two young at a birth."

The specimen in the Zoological Society's Gardens will eat nothing but vegetable food. Dr. Simpson was informed by the natives of Thibet that it lives chiefly on the berries and fruits of some trees which abound in that country; and Mr. Bartlett, the judicious superintendent of the Zoological Society's collection, has provided it with a wholesome diet of oatmeal porridge and arrowroot, which it seems to like. The racoon and coatimundi, on the contrary, will eat only flesh. This specimen is full grown, and probably two or three years old. It is engraved in the *Illustrated London News*.

THE CAPE ANT-EATER.

The Zoological Society has lately added to its collection in the Regent's Park Gardens the first specimen yet seen in

Europe of the Cape Ant-eater (*Orycteropus Capensis*), the "earth-pig," or *aard-vark*, as it is called by the Dutch colonists. Sir George Grey, when Governor at the Cape, made several efforts to get this animal for the Society; it was dug out of its burrow, but could not be taken alive. This one, an adult male, was purchased at Port Elizabeth, Algoa Bay, by Captain Ladds, commodore of the Union Mail Steam-packet Company's vessels, by whom it was brought to Southampton. It is quite different from the South-American ant-eater (*Myrmecophaga jubata*), of which species there are two fine individuals in the collection.

Mr. Frank Buckland, in *Land and Water*, gives the following popular description :—" As it lay among the straw, with its head nestled in the corner, it was in general appearance not unlike a pig. Its total length is 4 ft.; of this the head is 11 in. and the tail 1 ft. 6 in., and much the shape of the pigtails formerly worn by sailors. Its body is thick and corpulent, the hide tough and badger-like, and covered with a few short stiff hairs of a brownish colour tinged with red. The ears are long, measuring no less than 8 in. in length and 4 in. in width; they are of a milk-white colour, and the blue veins can be seen in them; they are like the ears of a lop-eared rabbit fixed upright. The head is long, and reminds one of a kangaroo; the jaws are prolonged so as somewhat to resemble one of the bottles in which light wines are served at table. The nose is not unlike that of a pig; it is directed upwards and forward, and the animal continually sniffs it about like a pig waiting to be fed. The entrances to the nostrils are protected with a fringe of stiff hair; the mouth is exceedingly small, about 2 in. in length, and looks like a simple slit cut in the head with a knife; it is capable of very little dilatation; the tongue is flat and slender, but not round, and it does not present the long and whiplike appearance we find in the South American ant-eater. The forelegs are short and amazingly powerful. Each foot is armed with four claws: these are powerful weapons, as hard as iron. Each claw has a trenchant or cutting edge; this edge is directed outwards on three of the claws and inwards on one of them, so that when the beast strikes he wields, as it were, a double-edged sword. There are five claws on each hinder leg; these are somewhat spade-shaped. Nature has strangely thought fit to solder up as it were the mouths of both the aard-vark of Africa and the ant-eater of South America. In both creatures the mouth is diminished to a minimum. The latter beast has no teeth at all; the jaws are like the beak of a bird from which the horny bill substance has been removed. The aard-vark, on the contrary, has teeth: five large teeth are found on each side both in the upper and lower jaws, and two or three smaller ones in front of them. The structure of these teeth is peculiar. In section they are exactly like the section of a cane—*i.e.*, their substance is composed entirely of a number of small tubes, parallel to each other, soldered together so as to make the whole tooth mass. This is

a form of tooth found in no other animal." This Cape ant-eater, since it has been placed under the care of Mr. Bartlett, superintendent of the gardens, is fed upon minced meat, of which it will eat three pounds weight a day.—*Illustrated London News*, where the animal is engraved.

THE ANDAMAN MONKEY.

An interesting stranger at the Gardens of the Zoological Society in Regent's Park is the female Monkey, of a species hitherto unknown to naturalists, which, having been for some time domesticated on board one of the ships of the Royal Navy, has learnt some of the sailors' tricks. The following account of this diverting animal is contributed by Mr. Frank Buckland to *Land and Water*:—"This new and unique monkey has been presented to the Zoological Society by Captain Brown, R.N., of Her Majesty's ship *Vigilant*. It dates its joining the ship's company from Port Blair, Andaman Islands, in the Gulf of Bengal, lat. 11.43 N., long. 92.47 E., in the year 1864. Jenny (for that is her name) is supposed to be eight or nine years old. For the last four years she has 'served' on board the ship, and, having passed all the dangers of the Abyssinian campaign, being discharged with a first-class certificate and silver chain and medal for good conduct, is now waiting to receive her share of the prizes taken during the time she was in Her Majesty's service. Jenny stands about 2 ft. 4 in. in height. In general appearance she is most like the 'pig-tailed' monkey (*Macacus nemestrinus*), but is at once distinguished from that species by a remarkable arrangement of the hair on the top of the head, which is somewhat of a V shape, and is parted down the middle. The hair itself is very fine, and is elegantly arranged round the ears. The first impression upon seeing this animal is that it is intermediate between *Macacus rhesus* and *Macacus nemestrinus*. The face is by no means fierce; the features may even be called good-natured. She has been made a great pet by the sailors. She walks upright on her hind legs with remarkable facility, and with much less effort than even the performing monkeys as seen in the London streets."—*Illustrated London News*, where the animal is engraved.

ANATOMY OF THE WOLF.

Professor Flowers has read to the Zoological Society a memoir on the anatomy of the Aard-Wolf (*Proteles cristatus*), founded on a specimen recently deceased in the Society's menagerie. The result arrived at after a careful examination of every part of this animal was that Proteles constituted of itself a distinct family of carnivorous animals, allied to the *Hyænidæ* and *Viverridæ*, but more closely to the former than Mr. Flower had previously supposed when he had only the skull of this remarkable animal to judge by. Mr. Flowers' paper was illustrated

by the exhibition of the stuffed skin, a complete skeleton, and a full series of anatomical preparations of the internal organs of this animal, all taken from the same individual.

NEW SPECIES OF DEER FROM CHINA.

In 1865 M. le Père Armand David, missionary of the congregation of Lazaristes at Pekin, and an active Correspondent of the authorities of the Jardin des Plantes of Paris, sent a notice to that celebrated institution of the existence, in one of the Imperial parks near the Chinese capital, of a strange species of Deer, something like the elk or moose of Northern Europe, but with a long tail and very curiously-branched horns, which he believed to be quite unknown to naturalists. The Chinese, says M. David, call this animal the "Mi-lou," or more often the "Sseu-pou-siang," the latter epithet meaning "not one of the four," because they fancy that it resembles the stag in its horns, the cow in its feet, the camel in its neck, and the ass in its tail, and is yet different from all of them. In the following year M. David, having succeeded, after many difficulties, in obtaining skins and parts of the skeleton of this singular beast, sent them, along with other specimens of natural history, to the museum of the French capital. Here they were handed over to the examination of M. Alphonse Milne-Edwards, one of the naturalists of that establishment, who shortly afterwards described them in the *Nouvelles Archives du Muséum,* to which he is a frequent contributor. M. Milne-Edwards proposed to call this new animal "elaphorus," being a deer with a tail to it, and "davidianus," after the name of its enterprising discoverer. But, although the French naturalists had the merit of discovering and describing this new and remarkable animal, the first living specimens of it imported into Europe have come to English shores. So soon as the intelligence of its existence reached the authorities of the Zoological Society of London, application was made to their excellent Correspondent at Pekin, Sir Rutherford Alcock, the British Ambassador to China, for his assistance in procuring examples of it for the society's menagerie. This was no easy matter, as the animal is only to be found in the Imperial parks near Pekin, which are guarded, particularly from foreigners, with the utmost jealousy, and recourse was obliged to be had to Prince Kung himself for leave to obtain living specimens. The young pair of animals were thus procured. The horns of the male are not yet developed, the female never possessing these appendages. But the long tail, and large ungainly feet, render them at once distinguishable from the ordinary deer, of which a full series is likewise exhibited in the Zoological Society's menagerie.—*Illustrated London News,* where the animal is engraved.

THE ELK IN ENGLAND.

Recent excavations of the East London Water Company, which have yielded so rich a booty to naturalists and antiquaries, have set for ever at rest the question whether the Elk (*Alces palmatus*) has been a denizen of our forest in post-tertiary times. Professor Owen, in a note on the subject, states that at the time of the publication of the *British Fossil Mammalia* he had not obtained satisfactory evidence of the occurrence of the elk. The first and only discovery of elk remains previous to the excavations at Walthamstow was that of an antler in a peat bog near the North Tyne River, Northumberland. This is recorded in the *Transactions* of the Tyneside Naturalists. Now, however, we have proof that the elk, as well as the reindeer, inhabited the forests round London. "In an old bed of the River Lea," Professor Owen writes, "at from 5 ft. to 8 ft. in depth, have been obtained remains of *Bos longifrons* and *Capra Hircus*, with remarkably fine horn cores, part of an antler, 2 ft. 8 in. long, of a reindeer (*C. tarandus*), and in another kind of deposit, as evidenced by the darker colour of the bones and a thin partial coating of limy matter, were obtained the humerus, antebrachium, and metacarpis of an elk, closely corresponding with those of the existing Scandinavian species." The characters of the bones of that peculiarly long-legged kind of deer called elk or moose differentiate them readily, Professor Owen adds, from those of the bovines, of the megaceros, and of the wapiti, or other large round-antlered deer. He is disposed to regard such bones as more satisfactory evidences of *Alces* than portions of antler. There seems to be a doubt whether the elk has ever been discovered fossil in France. But Professor Owen remarks that we owe to Julius Cæsar the valuable record of both the reindeer (*Bos Cervus*) and the elk (*Alces*) in the Black Forest and conterminous parts of Germany at the period of his campaigns.—*Medical Times and Gazette.*

THE MUSK-DEER.

A highly-interesting novelty has been received in the Zoological Society's Gardens in a young doe of the kustoora or musk animal (*Moschus moschiferus*) of high central Asia, being, probably, the first of its species that has ever been brought alive to Europe. This curious little animal is barely two-thirds grown, and at its present age it exhibits some peculiar markings, which disappear with full maturity. When adult it is rather more than 3 ft. in length, and stands nearly 2 ft. high at the shoulder; but musk-deer are said to vary in size, and chiefly according to the kind of locality frequented, those inhabiting dense and shady woods being invariably larger than those which live on open rocky ground. There is a good deal of the roe in its appearance; but its hind limbs are still longer, appearing disproportionately so on a level surface, even distantly recalling to

mind the kangaroo; and both the ordinary hoofs and the accessory or succentorial hoofs (which latter are considerably developed) of each foot spread out very widely. Like the roes (*Capreolus*), it is tailless. Its coat is remarkable, the hair of it being somewhat long, erect, soft, and tubular or quill-like, though unsubstantial, their tips forming an even surface—in fact, resembling that of sundry animals of similar habits, as notably the klip-springer (*Oreotragus saltatrix*) of the mountains of Africa. This sort of vesture is an admirable protection against cold or dry snow; but it soaks up water like a sponge, and therefore animals that are thus clad require to be carefully protected from wet. The male has a pair of tusks depending from the upper jaw, which grow to about 3 in. long, being sharp-pointed, and curving a little backwards. In this and in the absence of horns the musk-deer resembles the diminutive chevrotians, or mouse-deer (*Meminna* of India and *Tragulus* of the Malay countries); but it differs from them much in its proportions, in its vesture, habitat, and in the circumstance of the male bearing the famous "musk-pod" (as it is usually styled), which is so much in request as a valuable article of commerce. The female has no trace of this, nor does she give forth the slightest musky odour. Perhaps it is as well that the individual now received is of the feminine sex, as an old buck might possibly be a little too highly odoriferous for the olfactories of some visitors to the gardens. The stoutness of limb in the young animal recalls to mind the chamois, and there is something about its appearance which certainly reminds one of the kangaroo, as before remarked.

The musk-deer is characteristic of the elevated Thibetan region, and excels all the other mountain ruminants—even the chamois, the Himalayan goral, and the African klip-springer—in its power of traversing steep precipices. An elaborate account of it was published by the celebrated Himalayan and Thibetan sportsman, Frederick Wilson, of Mussoora, which has been reproduced, with some confirmatory remarks, in Colonel Markham's journal, entitled *Shooting in the Himalayas*. The Colonel remarks that "This little persecuted animal would probably have been left undisturbed to pass a life of peace and quietness in its native forests, but for the celebrated perfume with which it is provided. Its skin being worthless from the small size, the flesh alone would hold out no inducement for the villagers to hunt it while larger game was more easily procurable; and its comparative insignificance would alike have protected it from the pursuit of the European sportsman. As the musk, however, renders it to the Himalayan mountaineers the most valuable of all game, no animal is so universally sought after in every place that it is known to inhabit."—*Illustrated London News.*

VENEZUELAN BIRDS.

A COMMUNICATION has been read to the Zoological Society from Messrs Sclater and Salvin on a third collection of Venezuelan birds received from Mr. Göering. The present collection has been formed principally in the vicinity of the Lake of Valencia, and contained a remarkable new species of Jacamar, proposed to be called *Brachygalba Göeringi.*

ARRIVAL OF WILD ANIMALS.

MR. FRANK BUCKLAND, in *Land and Water*, gives, upon the authority of Mr. William Jemrach, son of the well-known animal dealer, the following account of one of the largest consignments of wild animals that ever arrived in Europe. A traveller, named M. Casanova, went some ten months since to Kassala, in Upper Nubia, on the confines of Abyssinia, for the purpose of collecting live animals. He succeeded so well in his undertaking that he got together 32 elephants, 8 giraffes, 20 antelopes, 16 buffaloes, two specimens of rhinoceros, one hippopotamus, 12 hyenas, 4 lions, 4 ostriches, 12 horn-bills, 2 adjutants, 1 bustard, and a number of small birds. With this "little lot" he started across the desert for Suakim, on the Red Sea. The elephants, giraffes, antelopes, and ostriches, walked the whole journey, with straps round their necks, some in tow of camels; all the other beasts were carried in cages lashed to camels, M. Casanova having brought with him iron bars which were made into suitable cages on the spot, as the animals were brought in by the hunters. The staff for the portage of his collection was therefore very large; it consisted of 300 Arabs, 95 camels, and 80 goats, the latter being required to supply milk for the hippopotamus and the two young rhinoceroses .He had also to carry a large supply of water for the other animals. He was six weeks on the march from Kassala to Suakim, and, to add to his cares, a poisonous fly bit him in the temple, causing him a wound that nearly blinded him. He arrived at Suakim with most of his animals in good health, and transported them in a steamer to Suez; he lost many animals during this voyage by the heat, and his stock of elephants was reduced to 16; the two largest elephants, which were nearly full grown, and had tusks between three and four feet long, had got loose from the keepers while crossing the desert and escaped. Between Suez and Alexandria five young elephants were killed by accident. At Alexandria the beasts were put on board ship, the elephants, ostriches, &c., being hoisted on slings; all this was done without any accident. Landing at Trieste, the elephants were driven through the streets to the station, the ostriches, antelopes, &c., following the elephants wherever they went. A journey of three days and three nights, including stoppages, brought the precious cargo to Hamburg, and the muster-roll being called, poor M. Casanova found that his valuable property had suffered sadly by death and accident between Nubia and Hamburg. The following is a list of the survivors:—11 elephants, 5 giraffes, 6 antelopes, no buffaloes,

one rhinoceros, no hippopotamus, 12 hyænas, no lions, 7 hornbills, 2 adjutants, and 4 ostriches. Mr. Jamrach has now two elephants and a giraffe. By far the most valuable of all the animals is the rhinoceros; it is one of the two-horned species (*Rhinoceros Africanus*). Though young it is a fine healthy animal. It differs much from the Indian rhinoceros; the lower lip is pointed to such a degree that the German keeper remarked that "he looked like a young elephant that had not grown his trunk." This animal has not been seen in Europe alive since the time of the Romans. The price is £1,000.

THE SALMON IN TASMANIA.

The official Report of the "Salmon Commissioners" to the Governor of Tasmania, dated Sept. 2nd last, has been received in this country. It shows that the attempt made to introduce the salmon into the rivers of Van Diemen's Land has been completely successful. During the months of September and October, 1867, the swarm of young fish hatched from the ova sent out from England in 1866, comprising about 6,000 salmon and 900 salmon trout, were let out from their nursery, and made their way down to the sea. In a former Report the Commissioners had stated that salmon had been seen in the Derwent, and they now state that with a view to confirm the fact, attempts had been made to capture some of the fish. These attempts unfortunately failed, owing to the nets having been rent by the strong current of the river, or torn and entangled by the rocks and sunken timber which encumber the bed; while the use of the rod has been prevented by the dense brushwood that almost everywhere covers the banks. Nevertheless we are told that "these difficulties will not deter the Commissioners from continuing their efforts to satisfy the public desire to obtain this crowning proof of the presence of the salmon in the Derwent."

Meanwhile, they publish pages of evidence that the fish, in large numbers and of great size, have really been seen in the river. Trout and salmon-trout also thrive surprisingly; and as there are now four generations of trout in the river, their future increase will be beyond calculation. They are still multiplied also in breeding-nests in shallow rivulets; and eggs and young fish have been sent to New Zealand, to Australia, to fourteen different places and waters within the colony of Tasmania itself, and with successful results. Of the salmon-trout that were bred, a few pairs were detained and placed in small ponds by way of experiment, to see if they would live and breed in fresh water. The result was all that could be wished; for "in the month of April last it was discovered that some of the fish were gravid with spawn; and on June 26th the first pair began to form their nests and to deposit and fructify their ova. Other pairs soon began the same operations, resulting in the production of several thousand healthy ova, from which a considerable number of young fish will soon be forthcoming."

Thus the Commissioners will be able to stock all the rivers of the island, and to spare a supply for all the rivers of New Zealand and Australia. But the sea trout is not to be introduced into the Tasmanian rivers until after the salmon has become completely domiciliated therein. They (the Commissioners) have hitherto carried on all the operations among themselves; but they are of opinion "that at no distant date, when the undertaking has become more developed, further assistance will be required, and it will probably become necessary to obtain the services of a practical fisherman from England."—*Athenæum.*

THE ENGLISH SALMON FISHERIES.

The long drought of the past year interfered materially with the capture of Salmon by rod and line on English waters. The rivers, however, are reported to be well stocked with fish, and the total take of salmon on the rivers, taken collectively, was about the average. Although the anglers on the Severn were not very fortunate, the nets in the non-tidal portion of the river did pretty well. Over 450 salmon were taken between the weir at Tewkesbury and Milford-weir, including also a portion of the Verniew. Of these only 14 were captured with the rod. The remainder were taken with draught and bush nets. In the tidal portion of the river the number of salmon captured by nets and fixed engines amounted to upwards of 11,000. The total weight of all the fish caught is estimated at 58 tons, the commercial value of which may be fixed at 8,000*l.* During the season a large number of fine fish were taken, and the capture of grilse was fair. On the Chester Dee the angling was most unsatisfactory. Although the tidal fisheries were very productive, the anglers in the upper waters had little sport, the best station on the river yielding only four salmon during the entire season. On both the Wye and the Usk the angling was indifferent. On the former river the estuary fisheries are reported not to have taken so many fish as in the previous year, while the capture both by rods and nets in the upper portion of the river was somewhat better than in 1868. The angling on the Usk, although better than last year, was not very good. The capture of fish in the Taw and Torridge was not satisfactory; the weather was most unfavourable for angling, and the small take of fish is attributed solely to the low state of the water during the greater part of the year. The autumn angling in the Lune is reported to have been very good. The heavy flood brought up a number of fish, and towards the close of the season some capital sport was obtained. The spring angling on the Eden was good, and both the Eden and the Derwent yielded several large fish towards the close of the season. The number of salmon taken by the anglers on the Tyne this year was very small; indeed, for many years there has not been such a poor angling season. The gradual increase in the produce of our rivers since the Salmon Fishery Acts came

into operation is satisfactory. In 1861, 404 boxes of salmon were received at Billingsgate from English and Welsh rivers; in 1865, 868 boxes were received, while two years after the number of boxes had increased to 2,405. Our present inspectors, Messrs. Buckland and Walpole, have entered into the work of salmon restoration with great vigour, and are very confident that under amended legislation our salmon fisheries may be developed to an extent which will give them a position among the natural resources of the country.—*Times.*

FORMIDABLE LITTLE FISHES.

PAZI, in his *Travels in South America*, describes as "a source of anxiety to divers several dangerous fish among the multitude struggling in the water, such as the Rayfish, whose tail is furnished with a sting three inches long, with which it inflicts a very painful wound; Electric Eels, whose touch alone will paralyse in an instant the muscles of the strongest man; and the Payara, shaped somewhat like a sabre, and equally dangerous. The lower jaw of this last is furnished with a formidable pair of fangs, not unlike those of the rattlesnake; with these it inflicts as smooth a gash as if cut with a razor; and, finally, the caribe, whose ravenous and bloodthirsty propensities have caused it to be likened to the cannibal tribe of Indians, once the terror of those regions, but now scattered over the towns and villages along the course of the Orinoco. Each time the nets were hauled on shore, half-a-score or more of these little pests were to be seen jumping in the crowd, their jaws wide open, tearing whatever came in their way, especially the meshes of the nets, which they soon rendered useless. Their sharp triangular teeth, arranged in the same manner as those of the shark, are so strong, that neither copper, steel, nor twine can withstand them. The sight of any red substance, blood especially, seems to rouse their sanguinary appetite; and as they usually go in swarms, it is extremely dangerous for man or beast to enter the water with even a scratch upon their bodies. Horses wounded with the spur are particularly exposed to their attacks; and so rapid is the work of destruction, that unless immediate assistance is rendered, the fish soon penetrates the abdomen of the animal, and speedily reduces it to a skeleton; hence, doubtless, their appellation of mondonguero—tripe-eater. There are other varieties of the caribe in the rivers of the Llanos, but none so bold and bloodthirsty as this glutton of the waters. The inhabitants being often compelled to swim across streams infested by them, entertain more fear of these little creatures than of that world-renowned monster, the crocodile. This last, although a formidable antagonist in the water, can be easily avoided, and even conquered in single combat by daring men, while the former, from their diminutive size and greater numbers, can do more mischief in a short time than a legion of crocodiles."

PISCICULTURE.

From an interesting paper by Mr. Peek in the *Student*, it appears that the spawn of the lump-fish, the sticklebat, the sea-horse, and some others, is tended during hatching by the male fish, and not by the female. The cottus does not possess an air-bladder, and its proper position is at the bottom of the stream, among the insects and minute water-plants. Mr. Peek had an aquarium fitted up, in which he observed the process of incubation; and, after the eggs had been laid by the female in a loose cluster, among which a current of water could be maintained, the male fish took a position above them and kept fanning the water with his pectoral fins—an operation which he continued during thirty-five days, at the end of which time the small fishes escaped from the eggs. During the whole of this time the male fish did not eat, and appeared to be in a state of excitement, and if any object were dropped near the spawn, he would seize it and deposit it at the remotest corner of the tank. The female, after having laid the eggs, gave them no further attention, the operation of hatching being completed by the male.—*Illustrated London News.*

THE GROWTH OF SILK IN ENGLAND.

A correspondent of the *Times* offers a few remarks on the Cultivation of Silk in this country, more particularly as his experiment has been noticed by the President of the Silk Supply Association at Macclesfield and Coventry:—

"From the excellent produce of eggs imported from Milan and Japan in this season, which has been unfavourable both to the growth of the mulberry and the silkworm, I have no doubt that, with good eggs, care, cleanliness, and perfect ventilation, silk equal to the produce of Italy can be grown in England in the five weeks of May and June, with considerable profit to the cultivator, and opening up a large field of industry, more particularly to women and children.

"The white mulberry is of rapid growth in any soil, excepting chalk and clay; our light common lands, railway banks, and even hedgerows, might be planted with profit, if the tenant had an interest in the produce of the trees.

"The wonderful exhalation from the silkworm in the last age, which makes thorough ventilation absolutely necessary, will also make the care of these insects in the cottage very dangerous to the inmates; but any brick barn or spare room can be fitted up as a laboratory at little expense.

"A village girl, aged fifteen, had charge of my room this year. The rate of mortality, and of imperfect and double cocoons, did not exceed one per cent. There was very little refuse silk outside the cocoons, and all reel well at five to each thread. Although my winder only began the work last season, the weight of silk is above the average drawn from the same weight of Italian cocoons.

"My trees, varieties of the *Morus Alba*, planted in rows about ten feet apart, occupy about two acres of land, and yield on an average 25 lbs. of leaf each, some as much as 40 lbs. They can be propagated by cuttings, or three-year-old grafted trees can be bought at 150*s*. per 100.

"My harvest of cocoons has been limited this season by the failure of eggs imported from Stettin. I had arranged to feed the produce of four ounces of eggs, which would have consumed 3 tons 4 cwt. of leaf. The quality of the reeled silk has been fully tested at Manchester. The daily register of my hygrometer will remove the popular prejudice that this climate is too damp for the health of the silkworm."

NEW INSECTS.

Mr. Cutler, a visitor to the Entomological Society, has exhibited, on behalf of Mr. Christopher Ward, a number of Butterflies, of which the most interesting were the female of *Ornithoptera Brookeana*, from Borneo, and a specimen of *Papilio Antimachus*, captured about 150 or 200 miles inland from Old Calabar. The only example hitherto known of this gigantic and remarkable butterfly was collected by Smeathman a century ago, was figured both by Drury and Donovan, and, finally, was taken with Drury's collection to Australia by the late Mr. Macleay. Mr. Wormald exhibited some butterflies, sent from Shanghai by Mr. Pryer, including *Argynnis Midas*; and a species of Anthocaris with falcate wings, apparently identical with the Japanese *A. scolymus*. Mr. Dunning exhibited five specimens of Bombycidæ, sent from Shanghai by Mr. Holdsworth, and read a description by that gentleman of the larva, from a batch of which all five were reared; the moths had been compared by Mr. F. Moore with the types in the British Museum, described in Mr. Walker's catalogue of *Lepidoptera heterocera*; and of the five specimens three were referred to *Œona punctata*, one to *Lasiocampa remota*, and one to *Lebeda hebes*, which raised the question whether there was an error in Mr. Holdsworth's observations, or whether a single species had been simultaneously described by the same author under three different names, and referred to three different genera. The President exhibited a coloured drawing, sent to him by Mr. Birchall, of a large larva, doubtless a Chœrocampa, found in New Granada, on the trunk of an Avocado pear-tree, and remarkable for its close simulation of the appearance of one of the most poisonous snakes of the country, a large pupillate spot on either side of the head representing the eye of a snake.

COLOURING AND MIMICRY OF INSECTS.

In a paper read to the Entomological Society, it is stated that besides the varieties of Locustidiæ and Mantidæ, the Lepidoptera furnish numerous examples of protective colouring and of

mimicry. Among the former, he mentions *Loxura Alcides*, *Junonina anacarda*, *J. Œnone*, *J. Clelia*, *J. Amestris*, *J. Archesia*, *J. Ceryne*, *J. Pelarga*, *J. Hecate*, and the genus Nymphalis. Some of the Natal Diademæ, not protected in this manner, are found to mimic some of the Danaidæ. The Lycenidæ or "Blues" nearly all have protective colouring in their undersides. Most of the family of the Satyridæ illustrate the harmony existing between the colour of the insect and the character of its retreat. With respect to mimicry, Dr. Seemann said that he was of opinion, besides cases cited by Mr. Roland Trimens and Mr. Stainton of African butterflies, that one of the Natal butterflies (*Pentila tropicalis*) mimicked a diurnal moth, in whose company it was frequently found. The moth in question exudes a fluid like that of an Acræa.

WHITE ANTS.

MR. M'LACHLAN has exhibited to the Entomological Society specimens of a White Ant, brought by Mr. Mellis from St. Helena, where great damage has been done by them. It was doubtless imported into the island, and had the appearance of a West Indian or Brazilian species resembling the *Termes tenuis* of Dr. Hagen.

DESTRUCTIVE INSECTS.

THE damage caused in the vegetable world by Insects amounts every year to more than 100 millions of francs. Birds are incontestibly the best auxiliaries of man for the destruction of these hurtful little animals. The importance, therefore, is obvious of preserving and protecting the essentially insectivorous species. M. Millet, Inspector of Forests, who has taken great interest in this matter, has adopted the ingenious idea of providing artificial nests for them. In a late visit to the Parc des Princes, the Emperor noticed a number of these distributed about, and, on inquiring what they were intended for, was so pleased with the plan that he gave orders for a number to be placed in the Bois de Boulogne and the Tuileries gardens. Accordingly, a number of these nests have been placed there,

As a means of destroying vermin, the carbonate of baryta is recommended as the surest and swiftest poison available. It is a dry, white, tasteless powder, which may be beaten up with raw flesh, dripping, or meal, and thrust into the holes or among the runs of rats, mice, and other small game.

BRITISH SOCIAL WASPS AND THEIR NESTS.

IN an exhaustive paper on this subject, in the *Saturday Review*, we find this very able summary. Of true *Vespidæ*, or Social Wasps, we have in this country seven species of the typical genus *vespa*, including the hornet (*V. crabro*). The *Polistes*,

which makes its nest without any outer covering, the "pasteboard wasp" of British Guiana, the mud wasp of India, and such as hang their flimsy structures by threads to twigs and leaves, are strangers to us. On the other hand, the *Vespæ* are unknown in Australia, though well represented in the Indian Archipelago. Of British species (*V. Crabro*, the great hornet, standing alone) three are tree wasps—namely, *V. Britannica*, *V. Sylvestris*, and *V. Arborea* or *Borealis*. Three build by preference underground —*V. Germanica*, *V. Vulgaris*, and *V. Rufa*. The specific distinctions among these are best shown by the aid of illustrations, which in Dr. Ormerod's work (*British Social Wasps*) are of unequal merit. The best of this series strikes us as *V. Crabro*, which is firmly and symmetrically drawn. In most of the specimens the wings are not only far too long, but also fail to render the nervures or outlines with character and precision. In Plate IV. the male of *V. Vulgaris* has wings that never belonged to a wasp, and the worker of *V. Rufa* has unknown antennæ, with the eyes and head of a fly. The diagrams of wasp faces are much better done. The drawings of nests lack definiteness of outline, especially the last, taken we should say from a photograph, which ought to render better the geometrical rigour and truth which marks the paper fabric of the wasp, even beyond that of her wax-secreting congener the bee. We would recommend our readers to go—Dr. Ormerod's excellent monograph in hand—to the nest-room in the British Museum, there to study the admirable collection of nests, British and foreign, arranged under the care of Mr. F. Smith. Conspicuous amongst these are the curious results of experiments made by the late Mr. Stone in artificial wasp architecture. By the use of wires and bits of pasteboard, to lay down the leading lines of the fabric, the labours of the tiny builders may be made to result in an edifice hardly less complex or elaborate than St. Paul's itself. One of the most valuable parts of Dr. Ormerod's book is that in which he shows the various forms of cells, and their aggregates into nests, to be typical of the species of their builders. He is right in insisting upon the fact of the distinctive architecture of insects such as these not arising out of any external physical necessity, but out of an inner subjective influence, or instinctive impulse.

It has been sought of late to detract from the geometrical exactness popularly assigned to the cells of bees and wasps. Their hexagonal form has been explained as the mere result of uniform lateral pressure, under which cylinders of any soft substance take the form of hexagons as the nearest polygonal figure capable of filling space. Actual observation has, however, disposed of this damaging hypothesis. Certain wasps do indeed make their combs—very small ones—entirely of cylindrical cells, the lateral pressure notwithstanding. But in the ordinary case the hexagonal principle is manifest even in the rudimentary basis of the destined comb. Still more clearly is it seen in cases where

the industry of the wasp seems to find a supererogatory vent in a lacework of detached cells exterior to the walls of the house. On the unfinished margin of such a series may be seen stretching out unmistakable straight lines, the embryonic walls of hexagons never to be fully enclosed.*

RARE HYMENOPTERA.

PROFESSOR WESTWOOD has exhibited to the Entomological Society three species of epyris and some other remarkable hymenoptera, including a calyoza from Port Natal, identical with one of the forms described by him many years ago, which were found in gum copal. Mr. F. Smith exhibited both sexes of Cynips, the male having been recently detected by Mr. Walsh in America.

EXTRAORDINARY FUNGUS.

MR. PASCOE has exhibited to the Entomological Society a number of Heteromera from Australia; one new species of Saragus was remarkable for a peculiar growth, said to be a fungus, existing during the life of the beetle, and completely covering it.

DEEP-SEA DREDGING.

DR. W. B. CARPENTER has delivered at the Royal Institution a discourse on the Temperature and Animal Life of the Deep Sea, in which he gave an account of the chief results obtained by himself and Dr. Wyville Thomson, in their dredging operations in the seas to the north of the British Isles, carried on last autumn in Her Majesty's steam-vessel *Lightning*, which the Admiralty had placed at their disposal, in compliance with the request of the Council of the Royal Society. After a few preliminary remarks, Dr. Carpenter briefly noticed the researches of preceding inquirers. General Sabine recorded in 1818 that, while sounding in the Arctic Sea, at the depth of 1,000 fathoms, the line brought a fine star-fish, with mud, containing specimens of lumbricus tubicola, which had evidently lived at the bottom of the sea. The explorations of Professor Edward Forbes, which led him to the opinion that a zero of animal life would be found at 300 fathoms, did not go deeper than 230 fathoms; yet this high authority caused the general adoption of his opinion. Its fallacy, however, was demonstrated by the results of the dredgings made in Sir James Ross' Antarctic expedition. The microscopic examinations of deep soundings from the Atlantic Ocean, by Professor Bailey, in 1855, showed that none of them contained mineral matter, but that all were made up of the shells of globigerinæ and orbulinæ, and a fine mud derived from their disintegration; and similar conclusions regarding the extensive

* See "British Wasps and Nests," *Year-Book of Facts*, 1869, p. 196.

diffusion of these foraminifera over the sea-bottom of the North Atlantic were drawn by Professor Huxley from his examination of the soundings brought up by Commander Dayman from depths of from 1,700 to 2,400 fathoms. These results were also confirmed by the observations of Dr. Wallich, in the *Bulldog*, in 1860, who, among other animals, brought up a living serpula and a group of polyzoa from a depth of 680 fathoms, and hence concluded that the presence of a living fauna in the deeper abysses of the ocean, generally supposed to be altogether azoic or occupied only by animals of very low type, has been fully established. Professor Sars, of Christiana, has, by dredging between 200 and 450 fathoms, also collected 427 species of marine animals of various kinds.

In summing up the results of the dredgings of Dr. Thomson and himself, Dr. Carpenter stated that their researches had established the existence in the cold area of a minimum temperature, at least as low as 32 deg. Fahr., over a considerable area, where the depth was 500 fathoms; and that there was no physical improbability in the existence of a stratum of sea water at a temperature of 32 deg., or even of 28 deg., since sea water, by virtue of its saline impregnation, contracts continuously down to its freezing point, which is below 28 deg.; that in the warm area, at 650 fathoms depth, the temperature was 46 deg., the surface being 53 deg.; that the distribution of animal life beyond the littoral zone is more closely related to the temperature of the water than to its depth; that on the sea-bottom of large areas of the North Atlantic there exists a stratum of calcareous mud, partly composed of living foraminifera, partly of the disintegrated shells of former generations, and partly of the coccoliths of Professor Huxley and the coccospheres of Dr. Wallich, with the admixture of other constituents; that the mass of this mud is penetrated by a living organism of a type lower than sponges and rhizopods, which Huxley names "bathybius;" that there is a remarkable resemblance between this calcareous deposit and the great chalk formation; that the area over which this deposit is being formed is peopled by a variety of higher types of marine animals, many of which carry us back to the cretaceous epoch, containing many species hitherto considered extinct, so that we may be said to be still living in the cretaceous epoch; that henceforth no valid inference can be drawn from either the absence or scantiness of organic remains in any sedimentary rocks as to the depth at which it was deposited, since it has been proved the deepest waters may be rich in animal life, and shallow waters almost azoic; and that these two conditions also exist at corresponding depths over wide contiguous areas of the sea bottom, in virtue solely of the fact that one area is traversed by an equatorial and the other by a polar current; and, finally, that as there have been deep seas in all geological epochs, so there must have been varieties in submarine climate, at least as great as those recently discovered, depending upon these currents.

Dr. Wallich has addressed to the *Times* a letter upon this very interesting subject, in which he says:—"While anxious to acknowledge to the fullest extent all that has been achieved by Dr. Carpenter and his associates, both as regards the publication of really original facts and the confirmation of those previously recorded by others, through the mere multiplication of the same kind of evidence, I feel warranted in asserting (and I need only refer to the pages of the *London Quarterly Review*, the *Athenæum*, the *Critic*, the *Reader*, and various other leading scientific journals of the period, to bear me out in what I say) that nine years ago I was the first to prove not only the all-important fact that animal life of highly organized types exists in the profounder depths of the ocean, but also to afford a detailed exposition of the several conditions which prevail, and under which alone animal life can be there sustained.

"It is true that my views failed at the time to receive that amount of credence which has recently been accorded them. But surely this of itself furnishes an answer to the somewhat reckless statement of those who would have it appear that they accepted those views, although silently, and are, consequently, not among the number of distinguished philosophers who, according to the published declaration of Professor Wyville Thomson, had up to that period 'accepted without question' Edward Forbes's theory regarding the extinction of life at depths exceeding 300 fathoms. It has, moreover, been averred that the observation made by Sir John Ross, in Baffin's Bay, in 1818—that is to say, some forty years previously—rendered Forbes's theory untenable. Let me ask how comes it, then, that Sir John Ross' statement remained universally ignored until I claimed for it its due meed of recognition in my work on the *North Atlantic Sea-Bed*, published in 1863? And how comes it, if Forbes's theory was really discredited by that select body of philosophical eagles who profess at a glance to set a stamp on all true discovery, that not one of them ventured boldly to disprove it, or took on himself the task which devolved on me of indicating from personal and hardly-earned experience that vegetable life, the pre-existence of which had been up to that period considered by the highest authorities (Professor Phillips, for example) as essential to the continuance of animal life, does not exist in the deep regions of the ocean? and, further, that the nutrition of the lowest forms of animal being is there dependent on special vital functions, which are perfectly distinct from and irreconcilable with those assigned to them in the writings of Dr. Carpenter or others?

"Dr. Carpenter, I am aware, endeavours to draw a distinction between discoveries achieved by the sounding machine and those achieved by the naturalist's dredge. Were such a distinction tenable, it is evident the title to many important scientific discoveries would resolve itself into a mere question of quantity. On this head, however, I beg to observe that my discovery of

highly organised types of animal life in the depths of the ocean was by no means an isolated one, as has been most ungenerously insinuated by Drs. Carpenter and Wyville Thomson. Nor was it at all unexpected on my part. While, as regards the form of instrument employed, it is only necessary for me to point out that I went on my North Atlantic cruise provided with dredging apparatus, but, although I begged hard to be permitted to use it in deep water, circumstances prevented my request from being attended to.

"It only remains for me to add that I am fully prepared to substantiate every assertion here made by means of published documents and correspondence."

The President of the Royal Society, in his Annual Address, thus refers to the expedition in which Dr. Carpenter, Prof. Wyville Thomson, and Mr. Gwyn Jeffreys, achieved such noteworthy results:—"The existence of deep-sea currents at very different temperatures in proximity to each other, and their influence on the inhabiting forms of life, and on the nature of the sea-bed, together with the great extension of our knowledge of the variety and characteristics of the new forms of life which have been discovered, justify the belief that we have embarked on a course of discovery and research which will not soon be exhausted, and which will have no unimportant bearing on the earlier geology of our globe, as our knowledge of the life at present existing on the submerged portion of its surface." The late Admiral Sir James Clark Ross' researches dredged up from the depths of the Antarctic Ocean specimens of animal species which were well known to him as inhabitants of the Arctic Ocean; and thereby is the inference confirmed that marine invertebrata are more widely spread than creatures of the land, inasmuch as they are added, as may be assumed, in their travels from one polar zone to the other, by the cold currents which maintain in the depths of the intervening seas the temperature to which they have been habituated.

THE PORTUGUESE MAN-OF-WAR.

Several specimens of the Physalia, or Portuguese man-of-war, have been picked up stranded on the beach at Southport. Though not entirely new to the British Marine Fauna, the occurrence of these beautiful and delicate inhabitants of more southern seas is excessively rare. Those found vary from an inch to two inches and a half in length, measured along the air sac. They still retained considerable beauty of colour, the sac being more or less suffused with pink, and the tentacles tinged with dark green. They were found in a few instances at high water mark, but most of them, from their lightness, were blown further in shore. They had more or less sand adhering to them, and none of them showed signs of life.

ORIGIN OF INFUSORIA.

A VERY able paper on the molecular origin of Infusoria has been contributed to the *Popular Science Review* by Dr. Bennett. The doctrine of the transmigration of souls no doubt originated in the belief that life, like matter, is indestructible. Buffon propounded the doctrine that every molecule of a living being had a species of life of its own, and that the body of a plant or animal was only an aggregation of minute living beings arranged in a particular way. John Hunter adopted a similar view; and a similar view, it may be added, is now held by some of the most eminent living physiologists. It is well known that some forms of animal life may be propagated without generation by parents. Thus, as in the Aphis, two-winged insects will produce an animal without wings, from which ten or twelve generations may be derived apparently by the existence of ova within ova, until the last of the chain again produces a winged insect, when a new cycle begins as at first. This species of descent is what is called parthenogenesis, while direct descent from parents is called homogenesis, and life without descent is called heterogenesis. The infusoria which appear in animal and vegetable infusions after a certain time are not, in Dr. Bennett's opinion, in all cases traceable to the existence of germs floating in the air; but they originate in the oleo-albuminous molecules which, floating to the surface, form the pellicle or proligerous matter, where, under the influence of light, heat, and other suitable conditions, the molecules by their coalescence produce the lower forms of animal life.—*Illustrated London News.*

ITALIAN REPTILES.

A REPORT has been read to the Zoological Society by Dr. A. Günther on two collections of Indian Reptiles, recently received by the British Museum, one of which had been formed by Dr. Leith, in various parts of Western India; the second by Mr. Barnes, in Ceylon. Both were of much interest, and contained various new species, which are characterised in the present paper.

ANIMAL LIGHT.

IN the *Nautical Magazine* has appeared a most interesting inquiry into the causes of the luminous appearance of the sea, the animals which produce it, the experiments made by the author with the animals, and his conclusions, differing from those of previous experimenters. He sums up: "It seems proved by the foregoing experiments that, so far from the luminous substance being of a phosphorescent nature, it sometimes shows the strongest and most constant light when excluded from oxygen gas; that it in no circumstances undergoes any process like combustion, but is actually incapable of being inflamed; that the increase of heat, during the shining of the glow-worm, is an

accompaniment, and not an effect, of the phenomenon, and depends upon the excited state of the insect; and, lastly, that heat and electricity increase the exhibition of light, merely by operating like other stimuli upon the vital properties of the animal.

"In confirmation of these opinions, I may quote from high authority that the light of the glow-worm is not rendered more brilliant in oxygen, or in oxygenated muriatic gas, than in common air; and that it is not sensibly diminished in hydrogen gas.

"I shall terminate this paper by an enumeration of the several conclusions that are the result of the observations I have been able to make upon the phenomena of Animal Light. The property of emitting light is confined to animals of the simplest organisation, the greater number of which are inhabitants of the sea. The luminous property is not constant, but in general exists only at certain periods, and in particular states of the animal's body. The power of showing light resides in a peculiar substance or fluid, which is sometimes situated in a particular organ, and at others diffused throughout the animal's body. The light is differently regulated, when the luminous matter exists in the living body, and when it is abstracted from it. In the first case it is intermitting, or alternated with periods of darkness; is commonly produced or increased by a muscular effort, and is sometimes absolutely dependent upon the will of the animal. In the second case the luminous appearance is usually permanent until it becomes extinct, after which it may be restored by friction, concussion, and the application of warmth, which last cause operates on the luminous matter (while in the living body) only indirectly by exciting the animal. The luminous matter in all situations, so far from possessing phosphoric properties, is incombustible, and loses the quality of emitting light by being dried or much heated. The exhibition of light, however long it may be continued, causes no diminution of the bulk of the luminous matter. It does not require the presence of pure air, and is not extinguished by other gases.

"The luminous appearance of living animals is not exhausted by long continuance or frequent repetition, nor accumulated by exposure to natural light; it is therefore not dependent upon any foreign source, but inheres as a property in a peculiarly organised animal substance or fluid, and is regulated by the same laws which govern all the other functions of living beings. The light of the sea is always produced by living animals, and most frequently by the presence of the *Medusa scintillans*. When great numbers of this species approach the surface, they sometimes coalesce together, and cause that snowy or milky appearance of the sea which is so alarming to navigators. These animals, when congregated on the surface of the water, can produce a flash of light, somewhat like an electric corruscation. When the luminous Medusæ are very numerous, as frequently happens in confined bays, they form a considerable portion of

the mass of the sea, at which times they render the water heavier, and more nauseous to the taste; it is therefore advisable always to strain sea-water before it is drunk. The luminous property does not appear to have any connection with the economy of the animals that possess it, except in the flying insects, which by that means discover each other at night for the purpose of sexual congress."

A WHALE CAPTURED IN THE FIRTH OF FORTH.

A HUGE Whale has been cast ashore in the Firth of Forth, at Longniddry, some fifteen miles from Edinburgh, along the road to the south-eastern sea-coast. It was first seen blowing its water-spout thirty or forty feet high in the air, at a little distance from the shore. It drifted nearer with the strong tide, and finally got entangled amidst the rocks, from which it made desperate struggles to escape, but could not extricate itself. Several shots were fired at it, and at length it was exhausted by loss of blood. Two boys waded out, and stuck their pitchforks into its blubbery flanks. The whale continued to show signs of life long after the tide had left it, both by the blowholes and the tail. The nearest measurement that was made, we believe, gave the length from the tip or point of the mouth to the extremity of tail in a straight line as 78 ft. 9 in., and, following the curve of its side, as 80 ft. 9 in. Its girth round the thickest part is 33 ft.; the length of the fore fin is 11 ft.; and the breadth of tail 15 ft. 9 in. The measurement round the lower jaw, from eye to eye, is 39 ft.; the breadth from side to side of that jaw, 7 ft. 9 in.; and its length, in a straight line, is 17 ft. 9 in. The head is elongated and flattened, and the colour slate grey, with whitish tints beneath. The under jaw overshoots the upper jaw, but a great deal of the skin of the under jaw is pressed up, through the carcass lying so flat on the rocks. The eye is at the angle of the mouth, rather beyond the line and above it. It belongs to the species of *Physalus antiquorum*, or razor-back whales, one of which was found, in 1831, floating in Plymouth Sound, which was 102 ft. long and 75 ft. in circumference. There is the skeleton of another, caught near the Needles, Isle of Wight, in 1842, which is 75 ft. long; and in the Edinburgh National Museum of Science and Art is the skeleton of one found at North Berwick, 80 ft. long, with a head 23 ft wide. The Longniddry whale, after lying aground seven or eight days, was at length sold by auction for 120*l.*, to Mr. John Tait, oil merchant, of Kirkcaldy.

THE SHORE LARK.

A SHORE LARK was caught in a trap near Brighton on or about the 19th November, by a birdcatcher, and was about to be killed in cold blood, when Mr. Wykeham-Martin purchased it and saved its life. It would doubtless have been forthwith shot by

some one else if let fly again, and so he has since kept it in a cage, but this, much to his credit also, "3 ft. long by 18 in. wide." Very few have been noticed before. One at Sherringham, in Norfolk, in March, 1830; one in Lincolnshire, recorded by Mr. Eyton, of Eyton; two in Kent, mentioned by Mr. Yarrell; and one near Filey, in Yorkshire.

To this communication of the Rev. F. O. Morris to the *Times*, Mr. Robert Gray, Secretary to the Natural History Society of Glasgow, replied as follows:—"As the Rev. F. O. Morris, in his enumeration of places where this bird has been found in Great Britain, does not mention any Scottish locality in his recent letter, it may interest him and other naturalists to be made aware that in three instances at least specimens have been procured north of the Tweed—viz., in East Lothian, Fifeshire, and Aberdeenshire. The first recorded examples of the Shore Lark in any part of Scotland were procured in the Tyne estuary, near the residence of the Earl of Haddington, on the 10th of January, 1859, and were shown to myself shortly after their capture by the late Dr. Nelson, of Pitcox, near Dunbar. He had three specimens, all of which were obtained in the same place, and a notice of one of these appeared in the proceedings of the Royal Physical Society of Edinburgh for that year. Besides these examples, two were caught near St. Andrew's in the winter of 1865, and two others, which I have seen, were obtained near Aberdeen a few months ago.

"In the case of such birds as the Shore Lark there is not, I imagine, much risk of their meeting with so inhospitable a reception as Mr. Morris would seem to suppose all birds of their kind experience on landing on our shores. It would require a practised eye even to distinguish them when found mixing, as they generally do, with other birds. Ornithologists have yet much to learn regarding the distribution of species even in such narrow limits as the British Islands afford, and I would therefore be disposed not to interfere in the meantime with bird collectors, whose object in procuring specimens may be to widen our information on this point, by proving the presence of the birds at particular seasons, which, unfortunately, can only be done by the production of the specimens themselves.

"Having of late years directed my attention almost constantly to the occurrence of what are usually called rare birds in this country, and having personally visited nearly every collection, public and private, throughout Scotland, I have had evidence enough before me to show that many of these have a much wider range of flight than has been hitherto recorded, and that until more is known of the birds of Scotland, no definite idea can be entertained of the comparative numbers of the rarer species that have occurred within British limits."

OYSTER AND MUSSEL FISHERIES OF FRANCE.

MR. CHOLMONDELEY PENNELL, Inspector of Oyster Fisheries, having visited and inspected the principal French Oyster and Mussel Fisheries, in pursuance of instructions from the Board of Trade, has reported thereon.

Having completed his Report of what he saw and heard among the Oyster and Mussel Fisheries of France, Mr. Pennell adds some remarks upon the lessons we may learn from a comparison of the French system with our own. The Government in both countries recognises the necessity of protecting natural Oyster-beds from an exhaustive demand; but in England we are in favour of making it the interest of the fishermen to do that for themselves which in France the Government proposes to do for them. Mr. Pennell is of opinion, however, that in the instance of some of our fisheries, too extensive to be advantageously made the subject of Parliamentary grants to companies, corporations, or individuals, a local committee somewhat analogous to the annual commission of the French, but including a larger proportion of the representatives of the fishing interest, might well be established under the surveillance of the Government. The French principle of dividing the coast into districts appears to be an excellent one, inasmuch as it aims at giving each man in the district an interest in the prosperity of the fisheries, and prevents a sudden descent of large numbers of men from distant parts to clean out the oysters where there happens to be a good fall of spat, impoverishing the district as well as depriving the local dredgermen of that which is, after all, often the result of their own labour; but the districts are too large, and the interest of each person too small. It is a great grievance with the dredgermen all round our coasts that they do the principal part of the cultivating, and others come in, after recklessly dredging out and exhausting their own beds, and carry off the lion's share of the harvest, taking away every oyster, big or little, that they can dredge. Mr. Pennell is also of opinion that the natural system of oyster cultivation on foreshores and banks partially submerged, as pursued at Arcachon, is well worthy of trial on suitable spots on the British coasts. He believes that the English system of artificial culture, by means of tanks entirely excluded from the action of the tide, is in all respects a great improvement upon the French system of tile collectors and *parcs* on the foreshore. The tanks, or salt-water ponds, have been established in various parts of England, and have succeeded in every case in which the experiment has been fairly tried. Hurdles, fascines, tiles, and cultch have all been used with great success in these tanks. The mode of granting concessions in France is simpler and cheaper than ours, but our system of a sifting public inquiry on the spot is probably more advantageous in the end to all parties, and occupies much less time than that of France. Applicants in Great Britain often incur expense by the employment of expensive and unnecessary

legal machinery. The system of temporary local depôts, by which fishermen and dredgermen are enabled economically and conveniently to warehouse their produce or bait until required, is one which might be adopted in this country with great advantage, power being vested in the Board of Trade to authorise such concessions, under proper regulations, in cases where they deem it expedient.

The Mussel culture of France has been for many years an established success, but there are very few spots round our shores on which the Board of Trade, as guardians of public rights of navigation and anchorage, would probably permit of the construction of such *chevaux-de-frise* as those, for example, at Aiguillon, or of the artificial creation of submerged rocks, like the stone *écluses* of the Ile de Ré. Moreover, the English method of mussel culture is both simpler and less expensive, and the mussels usually supplied for consumption at Billingsgate and other large markets are cheaper, larger, and better fattened. Billingsgate, for example, draws its principal supplies of English mussels from Essex. These are purchased from Southend, Leigh, South Lynn, the coast of Devon, &c., and are simply laid down on the mud of the foreshore for seven or eight months, usually from January or February to August, when they are fit for market. During May, June, and July they are unmarketable, not having recovered from the effects of spawning. Mr. Pennell states the price of the English mussels at Billingsgate at 1*s.* 6*d.* per 42lb., or considerably less than half the price of the Aiguillon mussels, the Dutch and Belgian mussels ranging about one-sixth lower than the English. He concludes his report with a cordial acknowledgment of the courtesy and assistance received by him from all the officers of the French Government with whom his examination of the French fisheries brought him into contact.—*Times.*

BOTANY.

PLANTS INFECTED WITH A PARASITIC FUNGUS.

Miss Becker has exhibited to the British Association specimens of the common red Campion, *Lychnis diurna*, infested with a parasitic fungus allied to the "smut" in wheat, which develops its fructification in the anthers of the flower. The campion in its ordinary healthy state has flowers bearing stamens only or pistils only; but about half the plants infested with the parasitic fungus bear flowers with both stamen and pistil in the same flower. Miss Becker has never observed bisexual flowers on healthy plants, and attributed its occurrence in the flower she produced to the presence of this parasitic fungus. She had submitted a few of the flowers to Mr. Darwin, and he had suggested that the pollen being destroyed at an early period, the pistil was developed in compensation. But though this explanation appeared probable at first sight, she did not think the facts sus-

tained it. She believed the influence exerted by the parasite to be of a much more subtle and surprising character than this, and that instead of causing the development of the pistil in a plant which would have produced stamens only if left to itself, the fungus has the power to cause a plant which in its natural condition would have produced pistils only to develop stamens, in order that it (the fungus) might have anthers in which to develop its fructification, and that the capsule withers in consequence of the vital forces of the plant being unable to support both sets of organs. The parasite comes like a cuckoo; establishes itself in the flower of the Lychnis; and in order to nourish and find accommodation for the spores of the stranger, the plant's own offspring perishes. The diseased bisexual plants very rarely produce seed; but occasionally late in the season perfect capsules, bearing good seed, are found upon them. It was supposed that the spores of the fungus fell on the stigma of a flower, and infected all the seeds in that capsule; that those seeds which would have naturally produced stamens only remain unaffected in structure by the parasite, but have their pollen destroyed; that those plants which would have naturally produced pistils only develop these to a certain extent, but as the fungus, which pervades the tissues of the Lychnis, cannot produce spores without anthers to fructify in and pollen to feed on, it compels the plant it inhabits to develop them for its accommodation, and the effort of so doing exhausts the forces of the plant and causes the decay of the capsule—if, indeed, the previous stunting of the style does not prevent fertilization. The production of healthy capsules late in the season may be accounted for by supposing that the vigour of the fungus is exhausted, and, the pressure being removed, the plant resumes its natural functions. The fact that only about half the diseased plants are bisexual, favours the theory that the latter are female plants, in which the growth of stamens has been induced by the presence of the fungus.

BAMBOO FORESTS IN CHINA.

In the province of Chay-Kiang, China, there are whole forests of Bamboo, while that of Shantung is celebrated for the small, hard sort, which is excellent for poles and levers. The plant is floated down in large quantities to Canton, from Fo-Kien, Kiang-si, and especially Nam-hoo-foo. In every farm, whether large or small, there is, behind the house, a plot of ground of about 100 square yards, surrounded with a wide ditch filled with water, and entirely devoted to the cultivation of bamboo for domestic purposes. The grove thus formed generally becomes the favourite resort of turtle doves, usually gray with rose-coloured paws. In their large gardens the Chinese often intersperse black bamboos with artificial rocks, producing a charming effect. In every village there are two or more bamboo stores, where the reed is sorted according to size and thickness. To work it it should be

taken in its green state; for a clever hand will then split it lengthwise into thin laths, which may be plaited in a thousand ways. As it never breaks, but only bends, and is never attacked by either worms or putrefaction, it is used for bridges over small streams, and for water-pipes for the irrigation of the small bits of ground Chinese intrepidity has cultivated even in the least accessible places. The fisherman builds his hut on piles of strong bamboo driven into the bed of the river. The nets with which he catches his fish, the hat he has on his head, the coat he has on his back, are all bamboo; so is the *yolo*, or oar of his boat; so also is the mat stretched over the heads of his passengers to protect them from the sun. The masts, yards, sails, and cordage of all kinds in a junk are of the same valuable material. They also make paper of it by reducing its scrapings, when clean, to a process of maceration, and then mixing the pulp with isinglass.

THE WELLINGTONIAS AT MARIPOSA.

"A ROVING correspondent" writes to the *Times* from Sacramento, dated October 9: "I have just returned to this place from our Yosemite excursion. Though the valley has disappointed me, I am more than glad to have taken our forest ride and visited the big trees in the Mariposa district. They are monstrous. We left the valley at seven o'clock in the morning. The forest soon grew upon us. My companion said to me, 'I seem never to have seen trees before,' and yet those through which we rode were of no uncommon size for these parts. As we passed by one I said, 'Now, that is not an exceptional tree; let us measure it.' So we got off our horses, and taking out my tape I found it was, breast high, 18½ ft. in circumference. The trunks of many pines, too, run up far as clean as a mast. The sun striking on these, which are of a light yellowish-brown colour, and on those of the cedars, which are very large, clean, and reddish, gives marvellous vistas in the forest. Some trees are also loaded with bright green moss, and as the *arbor vitæ* reaches a great height—say 50 ft. or 60 ft.—its dark foliage adds to the play of colour which surrounds the traveller in these immense belts of timber. Large fallen rooting trunks and charred stumps are seen in all directions, and the sentiment of loneliness is increased by the thought that one might ride a thousand miles through the same scenes by following the course of the Sierra. But the grandest of all are, I think, reserved for the night. Part of the mountain, which we had been descending for hours, and which, covered with huge trees, rose high up from our resting-place, was on fire. We had been aware of much smoke during the day, but our track had not led us near the scene of the conflagration. The sight was infinitely grand. High up, as it were in the sky, were walls, towers, and pinnacles of fire. In some places it smouldered in long banks and lines of glowing red, and then arose in crackling pillars of flame, as some great tree broke into a blaze. Here and

there huge ladders of light seemed to reach up to the fiery firmament from the earth. The shifting of the flashes, as a trunk fell or some fresh branches were caught, gave an appearance as if some monster forms were moving about in the middle of the furnace. We stood long in silence looking at it. The fire was not very far off, perhaps two hours' ride, and reached only for some few miles. It had been burning for a month. The way in which it was piled upon itself and had crept up the mountain side, leaving great trunks to smoulder and glare for weeks beneath its course, gave it a perspective like that of Martin's pictures. We said it was worth coming to the Yosemite if it were only to behold such a scene as that. Altogether, what with the burning forest, the bark wigwams by which we stood, and the roaring log fire outside the ranch, around which rough men sat as if in a picture of Rembrandt, that evening was one of the most marked in our ten days' excursion to the valley.

"Next morning we started shortly after sunrise for the big trees. It was very cold, and we enjoyed the gallop which a comparatively level track gave us through the first part of the forest which we entered. Soon our paths grew too steep for more than a footpace. We went up and down among the trees for about two hours till our guide cried out, 'We shall come to one directly,' and sure enough there stood a red-barked monster dwarfing the large trunks among which it grew, as a full-grown tree does a crowd of saplings. Where were our pines, with their 18 ft. girth, by the side of a giant some 100 ft. round breast high? Of course the great size of the ordinary forest timber in which these huge growths are found takes off from their immense proportions, but if one were set upon a plain it would show like the Eddystone Lighthouse. To speak for myself, it was hard to realise that what we saw were trees. Their trunks, when we stood close to them, had almost the appearance of artificial structures. One that had fallen was hollow, and had been broken by its fall. We rode into the break and through the prostrate fragments as if it had been a tunnel. We climbed up on the trunk of another, also fallen, and when I had stepped 55 yards upon it I measured its circumference, and found it to be over 25 ft. Thus, with its bark on—it had been stripped—it would have been at least some 30 ft. in girth at a height of 170 ft. from the ground. But these were not the biggest that we saw.

"The bark of these trees is red, and nearly a foot thick. It lies on the trunk in rough longitudinal ridges like huge muscles, but is so soft that with my pocket-knife I cut off two great hunks from a portion which had been detached and lay upon the ground. The branches are short, and spring mainly from the upper part of the tree. The foliage is scant in proportion to the trunk, and the cones are little bigger then plovers' eggs. The tree itself is said to be a species of gigantic cedar; but it spends its strength in growing more wood than leaves. There are about 600 of these cedars, of different sizes, some being comparatively

small, in the Mariposa groups. I do not know the greatest height reached by any one of these, but in another grove the altitude of one is found to be 335 ft., and there also a fallen hollow trunk can be ridden through on horseback for a distance of 25 yards. The Mariposa group is not so well known as several others."

THE NUTMEG-TREE IN CALIFORNIA.

The Nutmeg-tree, it is reported, is found growing in the Sierra Nevada range in California. Some years ago nutmegs, equal in strength and flavour to those of the East Indies, were plucked on the head waters of the Feather River, Placer County. The tree resembles certain species of pine. In the early times of California, nutmegs were gathered in Placer County, and sold in small quantities.

CALIFORNIAN TEA.

Herr Schnell and his Japanese are in fine spirits. The rapidity of the growth of the three-year-old mulberry trees which they brought across the Pacific and planted some weeks ago is already astonishing. They have put out a great quantity of the seed-nuts of the tea plant, which are coming up finely. This is the beginning of a new and important industry. There is no doubt, Herr Schnell says, of the much better adaptability of our foothill lands to the culture of tea, as compared with Japan. Next year some trees will bear plucking, as they will be then four years old, and the quality of the beverage will be proved. As a rule, flavour in fruits and vegetables tends to delicacy rather than strength in this climate, and this tendency, though objectionable in fruits and berries, is favourable to tea. The finest qualities of tea come from the highest uplands of China and India, where snow lies sixty days in winter. In North Japan, whence this colony brought these plants, there are deep snows in winter. The higher we go up on our Sierra the finer will be the flavour of our teas.—*San Francisco Alta.*

GIGANTIC PLANT.

Living specimens have been forwarded to this country from Nicaragua of one of the most gigantic plants in the vegetable kingdom. It is closely allied to the Arums (or "Lord and Ladies") of our hedges, and until the present time has wholly escaped the notice of travelling botanists. It produces but one leaf, nearly 14 ft. in length, supported on a stalk 10 ft. long. The stem of the flower is a foot in circumference, the spathe or flower 2 ft. long, purplish blue in colour, with a powerful carrion-like odour. As this remarkable species of Aroideæ is quite new to science it has not yet received a name.—*Builder.*

SINGULAR PLANT.

There is at present in the possession of Mr. George Terrey, a builder in Clerkenwell (says a letter in the *Gardener's Magazine*), a most remarkable plant, for which the owner has refused considerable sums of money. It is about the size of an ordinary gooseberry-bush, and although living and growing, bears no semblance of vitality. It has no foliage, but little pellicles of flint bud out of the twigs and stems, which are likewise encircled with rings of flint at every joint. In some places the flint, which, it appears, has exuded from the plant itself, cases the stem like a pipe. The plant looks black and dead, but the twigs, instead of being brittle like dead wood, are tough as leather thongs. It has been suggested that the flint, which forms so large a component of plant life, has, by some freak of nature, been eliminated in this case from the natural vesicles of the plant, and developed outwardly instead.

OPIUM IN CHINA.

It appears from this year's consular Reports from China that the consumption of Opium in that empire is increasing, and that there is an increased growth of opium in China itself. Early in the year an Imperial decree was issued strictly prohibiting the cultivation of the poppy plant in the Chinese empire, and alleging that there would be danger of its interfering with the growth of food and causing a scarcity of the means of subsistence; the apprehension of loss of tariff duty by a lessened importation of Indian opium may, perhaps, have been an influential reason for the decree. It threatens offenders with merited punishment, but attaches no specific penalty to disobedience; and it is thought that this decree will have no more effect than that of 1865 to the same purport, and that it will most likely be chiefly used by officials as an occasion for extorting money from the pockets of producers. There is evidence of extensive poppy cultivation in several parts of China. It has spread rapidly within the last few years in the vast region of Eastern Mongolia and Northern Manchuria, and is thence brought down to the coast, competing with Indian opium in the Newchwang market. Opium is grown also in several southern provinces. It has been grown for years in the extreme south-west, in the province of Yunnan, the larger proportion of which has thrown off its allegiance, and is now practically an independent kingdom, governed by a Mahomedan, named Tu Wen-hsin, said to be styled by his subjects the "Hsi-Mi-Kuo-Wang," or "King of the Consolidated West," and who has established his Court at Taili-fu, not far from the frontier of Burmah, called by the Chinese "Mien-tien." Mr. Mongan, the British Consul at Tien-tsin, states that opium is brought into that port either crude or prepared. In the former state it is generally spoken of as "tu," earth, or clay, from its resemblance to lumps or cakes of common clay; and the native, as distinguished from the foreign, which is termed "yangtu," or foreign

earth, is called "hsi-tu," or western earth, a name which seems to have a geographical reference to producing provinces. Prepared opium, called "ya-pieu-kao," is at Tien-tsin generally composed of foreign and native drug boiled down, and often largely adulterated with glutinous substances, such as a decoction of the berries of a leguminous tree called the "huai-shu," which grows abundantly in that part of the country. In quality some of the Chinese opium is not much below Malwa; but it is inferior in strength and flavour, and smokers prefer the Indian drug, although its price may be double that of the native; and in fact the latter is chiefly used for mixing with the former, seven-tenths foreign to three-tenths native.—*Times.*

HEMLOCK NO POISON.

SCIENTIFIC discovery has destroyed another of our most popular theories. Hemlock, to which Socrates and Phocion were said to owe their death, is pronounced by Mr. Harley and other eminent toxicologists to be no poison at all. Sixty grains of tincture of hemlock were administered to a young woman without any apparent effects, and Mr. Harley, after a dose of 24 grains of the pure juice of the leaves of the hemlock, only experienced a slight muscular numbness, which passed off after an hour. From further experiments it appears that the common hemlock is neither a poison nor even a medicinal remedy. The facts relating to Socrates and Phocion may, however, be reasonably explained in another way. Hitherto dictionaries have always translated the Greek κώνειον and the Latin *cicuta* by our word "hemlock." Some change of classification has no doubt occurred. What the ancients called hemlock was, perhaps, the *cicuta virosa*, L., which is, in fact, a most poisonous plant.—*Pall-mall Gazette.*

TRUFFLE CULTIVATION.

WE should feel extremely glad if we could hold out any fair prospect of success as regards the Acclimatisation of Truffles. Though, however, every trial has failed in this country, and we may almost say the same of the Continent, there is no reason why attempts at the propagation of truffles should be as unsuccessful in Australia; but there is no chance of success unless the experiment be made in a calcareous soil, which seems to be a *sine quâ non* in Europe. It is getting rather late for truffles, and we should be inclined to wait till the end of the year, when they have just arrived at maturity. Specimens obtained at this season would probably rot before they reached their destination. We should moreover recommend that the experiment should not be confined to English truffles. It is possible that the French truffle, *Tuber melanospermum*, which might be procured in any quantity in France, might succeed better than our *Tuber æstivum*, and its aroma is far more powerful. If French truffles are em-

ployed it would be well not only to import with them a quantity of their native soil, but some ripe acorns, as they seem to be fond of oak roots, though they are certainly not parasites upon them. It is very true that a common practice in Touraine is simply to enclose a piece of ground and sow it with acorns, and in the course of a few years there is sure to be an abundant crop of truffles. It is often said that the acorns must be obtained from truffle grounds, but we believe that there is not the slightest foundation for this opinion. Beech seems more favourable to the growth of *tuber æstivum*, and it would be easy to put some beech mast amongst the soil, which might possibly retain its vegetative powers. The fructification of truffles is well known, but what is not well understood is the circumstances under which their sporidia vegetate, and the exact nature of the spawn. It is this circumstance, perhaps, which at present baffles all attempts at cultivation.—*Gardener's Chronicle.*

PROTOPLASM OF PLANTS.

In the *Comptes-Rendus* for February there is a paper by M. Béchamp calling attention to the existence of bacteria in the Protoplasm of Plants, and which are believed to have had their origin there in the coalescence of the normal molecules or microzymæ. Dr. Pennetier has lately published in Paris a work on *The Origin of Life*, in which much the same doctrines are propounded, and which are identical with those promulgated by Dr. Hughes Bennett.

COLOUR OF LEAVES.

The Leaves of many plants which were originally green become red in the autumn a change which has been conjectured to be brought about by the gradual generation of an acid within the leaf. Experiments have been made to test the soundness of this theory, and it has been found that red leaves exposed under a bell glass to the vapour of ammonia have their original green colour restored.

DEVELOPMENT OF CEREALS.

From continued observations and experiments, extended over nearly twenty years, Mr. Hallett has arrived at the following conclusions: "1. Every fully developed plant, whether of wheat, oats, or barley, presents an ear superior in productive power to any of the rest on that plant. 2. Every such plant contains one grain which, upon trial, proves more productive than any other. 3. The best grain in a given plant is found in its best ear. 4. The superior vigour of this grain is transmissible in different degrees to its progeny. 5. By repeated careful selection the superiority is accumulated. 6. The improvement, which is at first rapid, gradually, after a long series of years, is diminished in amount, and eventually so far arrested that, practically speak-

ing, a limit to improvement in the desired quality is reached. 7. By still continuing to select, the improvement is maintained and *practically* a fixed type is the result."

VEGETABLE MANURE.

LET Liebig be comforted. We may yet restore to our soil, and from an unexpected quarter, the annual waste of certain elements of their fertility. In the Atlantic Ocean, west of the Azores, there exists an area seven times larger than all Germany, according to Humboldt, completely covered with a dense mass of vegetation. This vast floating jungle is called the Saragossa Sea, and a M. J. Lavinière has calculated that it yearly produces enough vegetable matter to manure no less than 1,800,000,000 acres! Can these prodigious marine prairies and savannahs be utilized for the replenishment of our impoverishing husbandry? This French gentleman, with an original idea, has proposed to his agricultural society that the ships which are now occupied during the summer in cod-fishing shall in other seasons be employed in ploughing into the thick mass of seaweeds, and loading with cargoes for the Azores, where the vegetable matter can be dried and pressed, and, after having valuable salts extracted from it, can be conveyed as a condensed manure to Europe, or anywhere else. Such is the scheme, but many considerations have to be satisfied before that wet salt weed is profitably brought into competition with our highly-concentrated bird-dung, blood, and mineral manures; and Mr. Lawes, Mr. Odams, and their brother manufacturers will prosper some time before they are driven out of the market by M. Lavinière.—*Chamber of Agriculture Journal.*

INFLUENCE OF WOODLANDS ON CLIMATE.

ANOTHER instance (if another be wanted) of the Influence of Forests or Woodlands on Rainfall, and consequently on Climate, has made itself felt in Australia. In many districts the trees have been so wastefully cut down, that since 1863 the quantity of rain has gradually diminished from 37 inches in the year to 17 inches in 1868. Up to July of the present year—a period which includes two of the wettest months of the season—the fall amounted to 11 inches only. In the colony of Victoria the deficiency of moisture has become so serious, that the Government has appointed an Inspector of Forests, whose duty will be to prevent the destruction of existing forests, and establish nurseries of young trees in favourable situations. By this means the beauty and fertility of the country may be renewed and increased, and the climate rendered more agreeable than at present. Dr. Mueller, the Government botanist, has shown that individual settlers could do much towards giving the country a wooded [illegible] by dropping seeds of the Eucalyptus into cracks in the

ground at the commencement of the rainy season. If this advice be followed, and the Government measures succeed, meteorologists of two generations hence will have interesting facts to record of the climate of Victoria.—*Athenæum.*

MUSHROOM CULTURE IN FRANCE.

The cultivation of the edible Mushroom in spacious caverns underground is practised to a very great extent at several places within a moderate distance of Paris, not only for the supply of the Paris market, but also for exportation to England and other foreign countries. Some account of this curious subject will be found in Mr. Robinson's book, *The Parks, Promenades, and Gardens of Paris*, just published. One of the great places for the subterranean culture of the dainty condiment of an epicure's dinner is Montrouge, just outside the fortifications of Paris, on the southern side of the city. The mushroom-beds here are entirely underground—70 ft. or 80 ft. below the surface; so that a nearly uniform temperature is preserved all the year round, and mushrooms are thus grown at any season. These extensive catacombs, formed by long burrowing galleries, like those of a coal-mine, for the extraction of building stone, have no opening except a circular shaft, which resembles a well, to be descended by clambering down a perpendicular pole or mast, into the sides of which large wooden pegs are fixed, at intervals of 10 in. or 12 in., to rest the feet upon. A simple apparatus of a pulley and rope, worked by one horse, is used to lift the baskets from below, with mushrooms ready for sale, and the compost, of white gritty earth mixed with good stable manure, chiefly horse-dung, in which the mushrooms are grown. This compost is sent down and moulded into narrow beds, about 20 in. high, and of the same width, ranged along the sides of passages or galleries. They are kept exquisitely neat and smooth, not a speck of litter being allowed near them. The mushroom spawn is introduced to these beds either by flakes of earth taken from an old bed, in which mushrooms have already been grown, or else from a heap of decomposing stable manure, in which mushrooms have naturally been engendered; the latter method of spawning is preferred. The beds are covered with a layer of earth, an inch thick, this earth being merely the white rubbish left by the stone-cutters above. It is remarkable that the smallest piece of iron, even a rusty nail, will prevent the mushroom growing near it; and Mr. Robinson is informed that coal is likewise prejudicial. The mushroom-beds must be kept well watered. A bed will preserve its bearing qualities two or three months, after which time it is removed, the stuff being drawn up and cast aside when its fertilising powers are exhausted. There are six or seven miles of bedding laid in one of the caves at Montrouge. The height of the galleries varies in different parts, and in some places the labourer must work in a stooping attitude. The ventilation is assisted by an apparatus at the top of the shaft,

with a large wooden chimney. There are other mushroom-pits at Arcueil, Moulin de la Roche, St Germain, and Bagneux, and at Frépillon, near Méry-sur-Oise, in the abandoned stone-quarries; besides which, the cultivation of mushrooms in cellars and in the open air is still practised on a smaller scale.—*Abridged from the Illustrated London News.*

PREPARING CABINET SPECIMENS.

At a meeting of the Manchester Literary and Philosophical Society, Dr. Alcock has shown a preparation preserved by corrosive sublimate in a manner which he recommended for fine dissections. The preparation had been kept in an open cup for twelve months, simply water being added occasionally to supply what was lost by the evaporation. The advantages of the plan are very perfect preservation, no necessity for closing up so that the specimen could not be got at, no fear of losing a valuable dissection from accidental evaporation, as where spirit is used, and cheapness. The method adopted was to prepare a saturated solution of corrosive sublimate in alcohol, and when a dissection in water is in progress, a small quantity, as half a teaspoonful, of the solution is to be added from day to day if the slightest appearance of putrefaction is observed, but no more of it is used than is absolutely necessary; and by the time the dissection is completed, the specimen has become imperishable, from the union of the corrosive sublimate with the tissues, and it may then be kept in pure water, either open or mounted in the usual way.

PHYSICAL SCIENCE IN EDUCATION.

At the Liverpool Philomathic Society, Professor Huxley has spoken on the subject of the introduction of scientific training into the general education of the country. Upon no subject has the public mind been more educated, he was happy to say, than upon this particular topic of the introduction of science into education; and physical science was already recognised as a part of the curriculum at Harrow and Rugby, and some of our great schools, while ample preparations were being made for its introduction at Eaton and elsewhere. He would ask any one present who had chanced to take the profession of an engineer, how much time he had lost? because when he had left school he had had to take to pursuits which were absolutely novel and strange to him. In the interests of mankind and of fair play, why would not the clergy get some little tincture of physical science, and put themselves into a position to understand the difficulties which were forced upon the mind of every thoughtful and intelligent man?

Geology and Mineralogy.

ROYAL SOCIETY MEDALS.

Two bequests have fallen to the Royal Society during the year, one being the service of plate for which the coal-owners in the North subscribed 2,500*l*., and presented it to Sir Humphry Davy in acknowledgment of the service he had rendered to science and to humanity by his discovery of the Safety-lamp. According to the terms of Sir Humphry's will, the proceeds of the sale of this service of plate are to constitute a fund for a medal to be given once a year "for the most important discovery in chemistry in Europe or Anglo-America." The Council of the Royal Society have accepted the trust; so that henceforth a Davy Medal will appear among the honorary distinctions which they are called upon to confer. The dividend annually available will, we understand, be about 30*l*. For the other bequest the Society are indebted to the late Benjamin Oliveira, F.R.S., whose personal estate has been divided among five societies—the Royal, and the Royal Geographical, and three charitable institutions. The amount in this instance, after payment of expenses, is about 1,300*l*, for which, as may be read in Sir Edward Sabine's Anniversary Address, the Royal Society have found an excellent use.

ON A FRONTIER LINE OF ETHNOLOGY AND GEOLOGY, BY MR. H. H. HOWORTH.

The author in this paper correlates the pushing back of the Ugrian races by the Indo-Europeans with the synchronous disappearance of the post-pleistocene, or pre-historic, Fauna and Flora of Europe; believing that, before the twelfth century B.C. (before which we know of no occupants of Europe, except Ugrians), Europe formed one zoological and botanical province with Northern Asia, and that the Ugrian variety of man was as much a part of its differentiæ as the reindeer and musk-ox. This was accompanied by the vast alteration in climate we must deduce, from comparing the pages of Strabo, Pliny, Tacitus, and Cæsar, with the present condition of things. The climate is now such that the European isothermals are deflected from the normal course they follow, across Asia, to their abnormal one in Europe; and the author believes that, before the twelfth century B.C., when the pre-historic Fauna and Flora occupied all Europe, those isothermals traversed the whole of Europe at the same latitude they still follow in Asia. Their present flexion, he thinks, from a vast number of facts, is attributable almost solely to the Gulf Stream; so that we get an approximate date for the advent of the Gulf Stream, with its geological influences,

and thus obtain a fixed point from which to calculate, at some future day, a perfect geological calendar.—*Proceedings of the British Association.*

THE EGYPTIAN DESERT.

PROFESSOR OWEN has addressed a paper to the French Academy of Sciences, of which he is a foreign associate, on the geological nature of the Egyptian Desert along the line of the Suez Canal. After stating that he has collected fossil organic remains in the environs of Cairo, at Memphis, in the plains of Kalayat-Rayan, pertaining to the Libyan desert, which is remarkable for its abundance of petrified trunks of palm-trees, &c., in the ravine of Babel-Molook leading to the tombs of the Kings, at Thebes; and lastly, along the Salt-Water Canal between Port Said and Suez; he proceeds to show that from these remains it appears highly probable that the desert formerly was the bed of a sea, the upheaval of which formed the present isthmus. The fossils collected by Mr. Owen comprise a period extending from the upper oolitic formation and cretaceous beds to the tertiary period of the old cocene and middle miocene. In the cuttings between Ismailia and Suez the strata are generally horizontal; a slight obliquity denotes a local excess of upheaving force. At the Serapeum, near the great basin of the Bitter Lakes, the strata chiefly consists of fine sand, slightly agglomerated at times, and containing much flint with occasional nodules of hardened clay. North of the lakes the layers are decidedly argillaceous. The annual deposits of the Nile could not have commenced until after the upheaval of the mountain ranges, which led to the formation of rivers. The soil of Egypt seems therefore to be of comparatively the most recent date, and yet it was inhabited by the most ancient civilised society known. The discoveries of Mariette Bey at Saggarah and Memphis seem to have proved that the period of Cephren, the founder of the second pyramid, answers to the third reign of Manetho's fourth dynasty, or to 6,000 years before the present period.—*Illustrated London News.*

CONTRACTION OF IGNEOUS ROCKS ON COOLING.

MR. DAVID FORBES, F.R.S., writes to the *Athenæum*:—"In the *Athenæum* (No. 2147), I find a letter from Mr. H. P. Malet, in which that gentleman, referring to a notice (*Athenæum*, No. 2,143) of my experimental investigations into the amount of Contraction undergone by Silicated Rocks when passing from the molten into the solid and cold state, requests me, through the medium of your columns, to answer eight questions which he puts with reference to my experiments. I should gladly comply with this request, did I not fear that, in order to do so, I should be obliged to trespass too much upon your valuable space, and I must therefore content myself by referring to my original com-

munication on this subject in the *Chemical News* of October 23, 1868, in which every one of these questions will be found answered in full detail. Although I have not seen 'The Circle of Light,' in which Mr. Malet has published his reasons for supposing that such rocks could not have been formed by heat, I feel quite satisfied that we have now overwhelming evidence, physical, geological, and chemical, to prove that they must have once been in a fluid condition."

ORIGIN OF LAND SURFACES.

At the Royal Institution Mr. Archibald Geikie, F.R.S., director of the geological Survey of Scotland, has lectured upon the Origin of Land Surfaces. The next Saturday he gave a second lecture on the same subject. He principally devoted his attention to denudation, or the wearing down of hills and valleys by the action of water. He said that water acts more rapidly in changing external features of a country than is commonly supposed, gave the best evidence to be had, tending towards the conclus that in one million years—a very short time in geological scie —the present action of rain and rivers is competent to scoop a valley of very considerable dimensions. He narrated how freezing of water in the cracks of cliffs gradually detaches la fragments of rock from the main body, and he explained th springs of water escaping from the middle of a cliff tend undermine and overthrow superincumbent strata. Lastly, h called attention to the action of glaciers in the formation of undulating land surfaces, for these vast masses of ice rub down uneven surfaces of the land over which they travel, and p their paths to some extent by means of stones and mud.

PHYSICAL GEOGRAPHY OF WESTERN EUROPE.

A paper has been read to the Geological Society "On th Physical Geography of Western Europe during the Mesozoic an Cainozoic periods, elucidated by their Coral-faunas," by Mr. P Martin Duncan. The author noticed the typical species of the coral-fauna of the deep seas which bound continents remote from coral-reefs. He pointed out that a correspondence of physical conditions during the deposition of certain strata was indicated by their containing analogous forms,—the presence of compound cœnenchymal species indicating neighbouring reefs, and their absence in places where simple or non-cœnenchymal Madreporaria are found being characteristic of deep sea areas remote from the Coral-seas. By applying the principles thus elaborated to the evidence as to the condition of the seas of the European area from the Triassic period to the present time, the author then showed what must probably have been the physical condition of this part of the world at different periods. Prof. Agassiz accounted for the circumscribed area of many corals in the Atlantic

from the young of many coral species attaching themselves within a few hours of their becoming pelagic. He traced to the great equatorial current which must have traversed the Isthmus of Panama and the Sahara in a præcretaceous period, the distribution of certain forms, which the rising of the Isthmus of Panama eventually checked. Mr. J. Gwyn Jeffreys objected to the term "deep sea" being applied to a depth of 10 fathoms only, when the tide in some places rose to that extent, and the laminarian zone extended to 15 fathoms. Dr. Duncan remarked that the term "deep sea" had been given by Prof. Forbes to depths of 10 fathoms and upwards. For such depths as those explored in the present day no term short of "abyssal" was appropriate.

THE DEVONIAN PERIOD.

Mr. Godwin-Austen has read to the British Association a paper on the Probable Distribution of Land and Water during the Devonian Period, its fossil zoology and botany, and the physical changes which have taken place subsequently. He briefly sketched the order of successive sea-beds, and showed that these represented geological time. Of these, the Devonian group were among the earlier. Our rocks, sandstone or otherwise, were simply sea-bottoms, and the geologist only referred them to their original condition in order that he might deduce their physical and zoological history. The Devonian rocks had a wide geographical extent in Europe, Asia, and America. In the latter country there was a broad band of old Silurian rocks which existed as dry land during the Devonian epoch. In Great Britain the Devonian rocks had a general direction from north-east to south-west. From the nature of the fossil fishes of these rocks, Mr. Austen came to the conclusion that the old red sandstone was of fresh-water origin, as all these were of fresh-water habits. The dry land was covered with a series of great fresh-water lakes, like those of North America. Besides the strata deposited along the bottoms of these lakes, there was a series of vast marine deposits, which are termed Devonian. The old red sandstone group was a very perplexing one, and passed down into the Silurians at its base, and into the Carboniferous towards its upper portion. The most northern portion of this country where rocks containing true Devonian fossils came up was Lynton. The author then traced the easterly direction of the Devonian group, showing how they cropped up beyond the chalk of Boulogne, and thence across Belgium and Prussia into Bohemia and Russia. A discussion ensued, in which Professor Phillips, Mr. Pengelly, and several others took part; but some of Mr. Austen's opinions did not obtain general assent.

THE WATER-BEARING STRATA NEAR NORWICH.

Mr. J. E. Taylor has read to the British Association a paper on the Origin of Sandpipes in Chalk, showing them to be natural

drains, and advocating their origin from a chemical point of view. These sandpipes were most abundant in the disturbed chalk, and less so in the solid strata. The latter allowed the water to get away by means of joints and flint bands. The age of some of the sandpipes could be told by the material filling them, and by the unchanged contour of the country. In the excavations attending the sewage works at Norwich, much trouble was given by their having to work through strata thoroughly saturated with water. The same sort of strata standing above the water-level gave no trouble whatever. The deduction was drawn that if so much trouble ensued while working only 20 ft. below the water-level, the excavation of the proposed Channel tunnel, under so much more pressure, must necessarily be attended with great difficulties. Mr. Taylor gave an interesting statement of the manner in which the wells were drained by the pumping in the neighbourhood of Norwich, and showed they were affected according to the different nature of the strata in which they were sunk.

Mr. Godwin-Austen mentioned several localities in Devonshire where sandpipes occurred in the sandstone rocks, and thought that the chemical theory could not hold in cases like these, although they might do so in chalk districts.

Sir Willoughby Jones expressed his gratification at the papers which had been read, and, as a Norfolk man, said he could thoroughly bear out the correctness of Mr. Taylor's views. It was a very common thing for holes to be suddenly formed by the caving in of gravel and sand into the sandpipes.

Mr. Taylor, in reply to Professor Harkness, said that the upper and lower boulder clays in Norfolk were very distinct. The former were derived principally from the wreck of the lias beds, and the latter from the lower chalk and oolite. One was of a dark blue colour, and the other of an ochreous white.

ON CERTAIN PHENOMENA IN THE DRIFT, NEAR NORWICH. BY MR. J. E. TAYLOR.

In this communication to the British Association, Mr. Taylor said that, although there was the finest series of the Drift Beds in Norfolk to be found in Great Britain, still in the upper boulder clay certain anomalies occur which frequently puzzle the geologist. The paper was an attempt to explain these by referring them to the agency of icebergs. Sometimes there were found beds of upper boulder clay lying at lower levels than the middle drift beds. In fact, such phenomena occurred through icebergs having ploughed up the sands, and deposited beds of clay in the furrows. This accounted for the out-of-the-way character of what had been termed "Third, or Valley Boulder Clay." The sand beds on each side these linear extensions of clay were frequently dragged out of their place and contorted. The chalk also was disturbed, and the flint bands thrown into almost

perpendicular positions in the neighbourhood of such phenomena. Mr. Taylor also mentioned the exceedingly narrow track of these abnormal beds of clay, and concluded by showing that their occurrence only the more fully bore out the glacial hypothesis.

The President, Professor Harkness, said Mr. Taylor distinguished himself by working on the cray and drift beds of Norfolk, and that his paper was very valuable and interesting. He then traced the general relationship of the lower and upper boulder clays and of the middle drift beds. The first and last, he said, always showed strong evidences of ice action and arctic climature, the middle drift sands being marked by having numbers of non-arctic shell and flint pebbles. Professor Harkness reviewed the various localities where this was the case, both in England, Ireland, and Scotland.

Mr. S. Pattison, F.G.S., said similar phenomena to those mentioned by Mr. Taylor could be seen in the neighbourhood of Whitby. He had no doubt they were due to iceberg groovings.

FRESH-WATER DEPOSITS OF THE VALLEY OF THE RIVER LEA, IN ESSEX.

Mr. Henry Woodward has stated to the British Association that certain excavations made by the East London Waterworks Company had revealed the presence of shell marl on the Walthamstow Marshes. The marl was accompanied by vegetable remains and bog iron ore. All the shells are recent, and the most notable fact connected with the bed was the presence of bronze spear-heads, arrow-heads, knives, &c. These were accompanied by bones of man, wolf, fox, beaver, wild boar, red deer, roebuck, fallow deer, reindeer, &c., as well as of the sea eagle and fishes. As late as the year 1700, the entire tract was forest land. In 1154, the same country is described as abounding in wolves, wild boar, wild bulls, &c. Mr. Woodward thought that the maintenance of a royal forest had been the means of preserving this bed. In the deep cutting of the bed remains of the mammoth were met with. The author thought much of the deposit might fairly be ascribed to the beaver working and making dams in the old valley of the Lea.

Mr. Pattison said the implements were found in the upper or historical portions of the beds mentioned. Mr. Woodward, in reply, said the discovery of the beaver, red deer, and reindeer within seven miles of London was astonishing.

PALÆONTOLOGY OF INDIA AND EUROPE.

Dr. Oldham, in his Presidential Address to the Asiatic Society of Bengal, at their annual meeting in January last, made some remarks on the Palæontology of India and of Europe, in which he showed the necessity for caution in making comparisons and in drawing conclusions from fossil remains of the same species found in the two countries. He holds that the

basis of the classification hitherto adopted for the geologically recent deposits in India has been erroneous; and that to appeal to Europe for evidence of the geological age of Indian deposits is to appeal to witnesses who cannot know the facts. By this argument, Dr. Oldham supports the opinion expressed years ago by the late Dr. Falconer, that in India, if anywhere, would be found the solution of the great problem of the succession of life; and there, in the ancient alluvia of marvellous extent, might geologists hope to discover some of those intermediate forms which are extremely rare or altogether wanting in Europe.

THE MAMMOTH.

IN *Galignani's Messenger* we read as follows: "In May, 1860, the men engaged in the works of the Nethe Canal discovered, at about 150 paces from the Mechlin Gate, at Lierre, the skeleton of an enormous animal imbedded in the sand. It was lying on its right side, the vertebræ column greatly bent; the head and an immense tusk were entire. Nearly all the ribs of the left side were gone, and other parts were broken or in a state of decomposition. M. Scohy, an army physician, caused these precious remains to be transferred to a safe place, but the bony substance had become so brittle that the skull broke into upwards of 200 fragments during the operation, and other portions were similarly damaged. The whole was, however, deposited at the Museum of Brussels in a state of complete dislocation, which was daily getting worse, when the present director, M. Dupont, undertook its restoration. It took ten months to complete the task, and the mammoth of Lierre is now set up in the "Salle à Colonnes" of the establishment. This specimen measures 3·60 metres (11 feet) up to the withers, or three feet more than the skeleton of the adult Indian elephant belonging to the Museum; the height of the living one at the Zoological Garden being only 3·45. And yet this mammoth had not attained its *maximum* growth, since the epiphyses had not yet been converted into bone. Its age at the time of its death seems to have been about 35 or 40 years. The skull weighs 500 lbs., and the tusk is 9 feet and a half in length. By a peculiar system introduced here, the bones are not joined, as elsewhere, by means of wires passing through holes drilled into the osseous substance, but kept together by means of tightening screws. The whole skeleton can be taken to pieces in twenty minutes, and put together again in less than an hour. The bones wanting have been supplied by wooden copies of authenic ones; a tibia, and one of the ribs of the left side have been taken from another specimen of the same stature and age. It is well-known that the human species is contemporary with the mammoth, which belongs to the quaternary period."

EXTINCTION OF THE MAMMOTH.

A PAPER has been read to the British Association on this question, by Mr. H. H. Howorth, who does not think the Extinc-

tion of the Mammoth ought to be ascribed to the men of the stone age. He believes the extinction of the mammoth was simultaneous with the disappearance of a specific and distinct race of men from the same region.

Professor Boyd Dawkins stated that in England and Western Europe generally there was no doubt that the mammoth had become extinct by the hand of man. He also showed that the mammoth had lived when arctic animals existed. Mr. Howorth fixed the north-east corner of Siberia as the spot where the last mammoth lived.

DINOSAURIA.

A PAPER has been read to the Geological Society on the Dinosauria of the Trias, with Observations on the Classification of the Dinosauria, by Prof. Huxley. The author referred to the bibliographical history of the Dinosauria, which were first recognised as a distinct group by Hermann von Meyer in 1830. He proposed to divide the group into three families, viz., 1. The Megalosauridæ, with the genera Teratosaurus, Palæosaurus, Megalosaurus, Poikilopleuron, Lælaps, and probably Euskelosaurus; 2. The Scelidosauridæ, with the genera Thecodontosaurus, Hylæosaurus, Pholocanthus, and Acanthopholis; and 3. The Iguanodontidæ, with the genera Cetoisaurus, Iguanodon, Hypsilophodon, Hadrosaurus, and probably Stenopelys. Compsognathus was said to have points of affinity with the Dinosauria, in the ornithic character of its hind limbs. Hence the author proposed to regard Compsognathus as the representative of a group (Compsognatha) equivalent to the true Dinosauria, and forming, with them, an order to which he gave the name of Ornithoscelida. The author next treated of the relations of the Ornithoscelida to other reptiles and to birds. He then noticed the Dinosauria of the Trias, commencing with an historical account of our knowledge of the occurrence of such reptilian forms in beds of that age. In the discussion which followed, Sir Roderick Murchison elicited that the lowest formation in which the bird-like character of Dinosaurians was apparent, was to be recognized as low as the Trias, if not lower. In reference to differences of opinion which prevailed, Prof. Huxley observed that it was by discussion of opposite views that the truth was to be attained.—*Athenæum.*

ORGANIC REMAINS IN THE MENDIPS.

MR. C. MOORE has read to the British Association the Report of the Committee for the purpose of investigating the veins containing Organic Remains which occur in the mountain limestone of the Mendips and elsewhere. In his Report he referred to the various theories extant as to the origin of veins. They could not have been formed by sublimation, or the fossils

not be found in them. Mr. Moore was equally against the doctrine of segregation. Referring to Mr. Wallace's theory, that many of the veins had been filled up by superficial action since the glacial period, he pointed to the age of the fossils as decidedly against it. Mr. Moore's idea was that open fissures communicated with submarine floors and dwindled down below. The mollusca, &c., of these seas were deposited in the fissures. Three or four things were necessary to the formation of mineral veins—open crevices, the presence of certain minerals in the water of the seas, and electrical action. The Mendip Hills are intersected with veins, and on their tops some of these are worked. One of them extends for 270 ft. downwards, and contains abundant lias fossils, although no liassic rocks are nearer than several miles away. This proves how great must have been the denuding force. Mr. Moore has also discovered both land and fresh-water shells in these veins, as well as entomostraca, as well as seeds of old carboniferous plants. In the mines of North Wales he had found molluscan and fish remains, the latter belonging to no fewer than ten genera. Intermixed with the contents of some of the mineral veins, the author had found innumerable teeth of fishes, *conodonts*, nearly all of which were so small that they required optical power to see them. In the lead veins he had met with great quantities of foraminifera, all of secondary age. These veins also developed the existence of a fresh-water fauna, of coal measure age, having no fewer than nine genera, and 127 species.

Mr. H. Brady said three well-known genera of foraminifera had been mentioned by Mr. Moore, all of which still existed. One of the most abundant foraminifera, *Involutina*, was remarkable for its variety of form. Mr. Brady's remarks on the rest of these minute shells were of a purely technical character.

Professor Phillips said Mr. Moore had produced so many new facts that he was entitled to speculate. When he first heard of the discoveries, he was perfectly astonished. What had to be considered in the origin of mineral veins was the altered power of heated water as a solvent to take up and precipitate mineral matter. Mr. Brady's remarks on the alterations in the type of a certain foraminifera were valuable, for, if wide differences could occur in them, why not in animals of a higher organisation, such as lions and tigers? He referred to similar changes in the cephalopoda, and expressed his opinion that the understanding of lower types would make us better acquainted with higher forms. —*Athenæum.*

EXISTENCE OF THE MASTODON IN CALIFORNIA. BY PROFESSOR B. SILLIMAN.

DURING several visits to the gold regions of Tuolumne County, California, in the summer of 1867, I obtained evidence leading to the conclusion that the Mastodon, and perhaps the elephant, existed prior to the great volcanic disturbances and outpourings

of lava which occurred throughout the Sierra Nevada Mountains pending, or at the close of the epoch in which the deep-lying placers were produced. It is well known that this epoch of volcanic activity has been regarded as marking the period of the Pliocene, dividing it from the Post-Pliocene and existing epoch by a well-marked horizon. Among the animals whose remains have been found in this ancient auriferous detritus of California, preceding the epoch of volcanic activity, are the rhinoceros, an animal allied to the hippopotamus, an extinct species of horse, and a species allied to the camel, and resembling the Megalomeryx of Liedy. The remains of mastodon and elephant are found abundantly in the superficial detritus of the gold region, over an extended area, but until now they have never been certainly identified as occurring under the basalt which covers the ancient gold drift, and forms the highly characteristic ranges known as "Table Mountains."

Near Jamestown, a village in Tuolumne County, extensive explorations have been made during the past fourteen years in the deep-lying gold detritus, by tunnels driven in beneath the basaltic capping, at a level low enough to open the bed of the ancient rivers, in the channels of which rests the gold-bearing gravel. These tunnels are from a few hundred feet in length to 3,000 ft. or more ("New York Tunnel" 3,500 ft.), and they are from 200 ft. to 300 ft. below the nearly level surface of the basalt. They are driven as nearly as possible at right angles to the supposed course of the ancient stream, and in order to drain off the water by gravity, the grade commences often 150 ft. or more beneath the lip of the "rim rock" or margin of the old valley, aiming to come out in, or just beneath, the ancient channel or river bed. Underneath the basalt is a mass of stratified, almost horizontal, generally thin-bedded, detrital matter, alternating with clay and argillaceous zones, the thinly laminated beds containing often vegetable stems and impressions of leaves, indicating deposition in quiet water, while other portions are made up of coarse gravelly masses, compacted often into firm coherent "cement," as the miners call it. From the ancient river bed to the top of the basaltic capping of Table Mountain is certainly not less than 300 ft., probably somewhat more.

It is beneath this mass of matter, partly aqueous and partly volcanic in its origin, that the remains of the mastodon herein mentioned have been found. My attention was first called to them by discovering the portion of an *os illium* in the collection of A. B. Preston, Esq., local judge of Jamestown, which he assured me had been found in driving the so-called Humbug Tunnel under Table Mountain, at a point 1,500 ft. in from its mouth. Associated with it was the point of a tusk, which I also secured. Both these specimens are now in the collection of the Peabody Museum at Yale. Although I obtained the plainest possible testimony of eye-witnesses to the fact that these bones were taken from beneath the basalt, I should not venture to mention

the fact in support of the opinion that the mastodon existed in the Pliocene period, without farther and more satisfactory evidence.

This I was fortunate enough to obtain from Mr. D. T. Hughes, now engaged in exploring a tunnel upon the south-west side of the same mountain, which was formerly known as the Maine Boy's Tunnel, but now called after Mr. Hughes. Mr. Hughes informed me, that at a point about 1,600 ft. in the tunnel named, bones existed, believed by him to be those of mastodon or elephant, and which had been uncovered some time since, but were at the time of my visit inaccessible, owing to the falling in of that portion of the work. I immediately visited the place, and made all the examination possible at the time, but could not then nor on a later occasion gain access to the bones. At my request, explorations were resumed in the direction likely to uncover them, and I made arrangements to return to the locality whenever the miners should again reach these interesting remains, but up to the date of my leaving California (January, 1868) I was advised that this point had not yet been reached, and all I could do was to urge Mr. Hughes to use all diligence in the search, and communicate to me by letter a full notice of the facts as they should develop themselves. On March 24, I had the pleasure of receiving from him the following letter, dated Jeffersonville, February 22, 1868:—

"In compliance with your desire that I should write to you whenever I should reach the bones, I have now to state that I have reached them at last, and I regret very much that you were not here to examine them as they lay. The bones were very much decayed; indeed, so much so, that I found it impossible to obtain any of them whole, with the exception of four grinders, which I have in a very good state of preservation. The remains of this large animal were found 1,650 ft. in under the Table Mountain, and 4½ ft. above the ledge or bottom slate, embedded in a stratum of sand, overlaying a deposit of gold-bearing gravel, and scattered over a space 20 ft. long by 10 ft. or 12 ft. wide. A large portion of these bones were so soft that I could penetrate right into them with my fingers, while other pieces were a little harder, and looked very interesting. Some of the cavities were lined with yellow iron pyrites, and so bright, that when first exposed to the light of the candles, they glitter like diamonds. I have numerous fragments of different bones which bear handling very well when thoroughly dried. The two tusks lay together, embedded in the same stratum of sand, and very much decayed also. I endeavoured to remove them entire, or in medium sized pieces, so that I could put them together again, but I was unsuccessful, and found that nothing would hold them together. Both of the tusks were slightly curved, and large pieces of the points had been broken off, apparently. Each tusk measured, as I found them, 7 ft. 1 in. in length, and if whole would probably have measured 10 ft. They were not exactly

found, measuring 3 ft. from the end that enters the socket, 6 in. in one diameter and $5\frac{1}{4}$ in. in the other.

"The grinders, as before mentioned, are in a very good state of preservation. The two posterior grinders each measure 6 in. in length and $3\frac{1}{2}$ in. wide, and the two exterior measure each $4\frac{1}{2}$ in. in length and $2\frac{3}{4}$ in. wide. The enamel on the posterior ones is very perfect, but the exterior grinders are very much worn, apparently. I found it impossible, because of their softness, to get the dimensions of any of the other bones, which I regretted very much."

With this paper was sent a rough sketch of some of the teeth, with portions of the jaw; the two grinders in the same position as when dug out.

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From Mr. Hughes's description and the accompanying drawings there is no room to doubt that the bones discovered are those of the mastodon, and it appears probable that nearly the entire skeleton of a full-sized animal was entombed in the sands resting immediately upon the ancient auriferous gravel beneath the Table Mountains, and of course anterior in age to the period of volcanic activity and overflows of lava, which have hitherto been considered as marking the close of the Pliocene era, a catastrophe which appears to have exterminated the other members of the Pliocene fauna. If the mastodon survived the catastrophe which exterminated the hippopotamus, rhinoceros, tapir, &c., and continued through the Post-Pliocene to the appearance of man, it yet remains to be proved that man was his companion prior to the dawn of the existing epoch.—*American Journal of Arts and Sciences.*

KENT'S CAVERN.

MR. PENGELLY has read to the British Association the fifth Report of the Committee on the exploration of Kent's Cavern.* He said that beneath the floor of the vestibule was a layer of black soil, 6 in. to 9 in. deep, which had yielded 366 flint implements, bones and teeth of recent and extinct animals, charcoal, flint cones, &c. It had been objected that people could never have lived in the caverns, because smoke would have suffocated them. An experiment which had been tried, in burning six faggots of wood, showed the fallacy of the objection. In the exploration of the cavern, a daily journal had been kept, and every circumstance was noted down. 3,948 boxes of fossil bones had been found, and these Professor Boyd Dawkins undertook to examine for the purpose of determining the species to which they belonged. Among other objects, a bone needle had been found in the black band beneath the stalagmitic floor. The eye was capable of

* For Abstracts of the previous Reports, see *Year-Book of Facts* for the respective years.

carrying a thread the thickness of thin twine. A bone harpoon or fish-spear, forked on one side only, had been met with. Other undoubted evidences of early human art had been found. During the years 1868–9, Mr. Everitt, who is engaged by the Rajah of Sarawak to explore the cave of Borneo, visited Kent's Hole for the purpose of familiarising himself with the mode of operation. Mr. Pengelly then detailed the various layers underlying the stalagmitic floor, in which he was aided by a series of large diagrams. The cave earth, on floor underneath the stalagmite, was full of flint implements, teeth of the mammoth, bear, hyena, &c., and gnawed and split bones. Inscriptions dated 1688 had been found on the stalagmitic walls of that part of the cavern known as the crypt. The deduction drawn by Mr. Pengelly was that this period of time, although the dripping of the water was very copious, had been insufficient to coat over and obliterate the writing. This gives some idea of the immense age of the stalagmite floor, and of the time occupied in its formation. Beneath the earth was a breccia, and up to last year not the slightest traces of man had been found. This year, however, a flint flake was met with, thus carrying the antiquity of man further back. A monthly report had been sent up to Sir Charles Lyell. In some places, the stalagmitic floor was as much as 12 ft. thick. Associated with the flakes were the remains of the cave lion, the cave bear, the mammoth, &c. In fact, this was the most important anthropological relic which the cavern had yielded. Mr. John Evans, F.R.S., had seen the flint flake, and had declared it to be of undoubtedly human workmanship.

Professor Boyd Dawkins read a few notes on the mammalian remains mentioned by Mr. Pengelly. He showed that the various strata of the floor of the cavern contained remains of animals of different epochs, from the post-glacial upwards. During the time the black or upper band was being formed, a race of cannibals inhabited the cavern. The older deposits contained remains of the glutton, a species of hare larger than the existing type, the beaver, &c. Mr. Dawkins concluded by remarking on the vast antiquity of the human race as indicated by the facts mentioned in the Report.—*Athenæum.*

OBSIDIAN FROM JAVA, WITH A MICROSCOPICAL EXAMINATION.

Microscopists have lately urged the necessity and importance of examining rock sections with the Microscope. Little, however, appears to have been done in the accurate identification of the constituent minerals of the rock mass. Mr. W. C. Roberts has given to the British Association a statement of the result of the examination of a substance that, from the indefinite character of its composition, partakes of the nature of a rock rather than that of a mineral. It consists of a specimen of Obsidian from Java, originally in the cabinet of Bernard Woodward, Esq., but the label does not give the exact locality. It appears to differ much from that, also from Java, now in the British Museum.

The specific gravity of the specimen now produced is 2·35; in thin sections it is perfectly transparent. The lecturer gave a complete analysis of its composition, which he said may be easily cut into thin sections, and by the aid of a lower power, say 200 diameters, at least three distinct minerals (beautifully crystallised) may be distinguished, diagrams of which were produced with the specimen. These, with the optical properties, were admirably described, some doubt being expressed as to the nature of the second mineral; but the third was undoubtedly composed of magnetic iron.—*Athenæum.*

DISCOVERY OF FOSSIL PLANTS IN THE CAMBRIAN ROCKS NEAR ST. DAVID'S.

Dr. Hicks, in a communication to the British Association, has stated that the strata in which these Fossil Plants had been found were the Upper Longmynds. Their ripple-marked character showed they had been deposited in shallow water. In 1868, Professor Torrell reported his having found land plants in the Cambrian strata, and this encouraged Dr. Hicks to seek for them. He had been successful.

Professor Harkness said that there was a difference in the nature of the supposed plant remains. He mentioned the various theories afloat as to the nature of these plants, and said they might be fucoidal. Some of Dr. Hicks's specimens were, he thought, the tracks of marine worms. Dr. Hicks had sent fossils which were found 1,500 ft. below the horizons where they have hitherto been met with in the British Islands. They were, therefore, the earliest types of life which had hitherto been found in this country.

Professor Phillips thought that many of the so-called fossil plants in strata of this age might be referred to annelides. He thought the finding of the trilobites and other remains 1,500 ft. below the stage they had been found in before ought to teach geologists a valuable lesson. The learned Professor went into an elaborate review of the order of life, succession, and of the natural history classification of the early geological epochs. He thought it was the duty of the Association to encourage and support such able workers as Dr. Hicks.

Professor Etheridge said that the plants exhibited were quite of a different character to those shown by Professor Torrell last year. He thought they were nothing beyond furrows or tracks of annelides and crustacea. The number of generic species of trilobites, &c., showed that life was enjoyed in great abundance during these early epochs.

FOSSIL PLANTS FROM GREENLAND.

It is worth mentioning that some of the Fossil Plants recently brought from Greenland are identical with a few of those discovered at Bovey Tracey, Devonshire, by Mr. Pengelly, a

description of which was published in a recent volume of the *Philosophical Transactions*. Indeed, there seems reason to believe that the Greenland deposit is of the same period as other deposits in different parts of Europe, namely, the Miocene. A year or two ago one of the assistants on the Geological Survey of Ireland discovered fossil plant beds in the railway cutting through basalt, in the county Antrim, containing specimens of coniferæ, of cypress, of beech and oak, with sedges and grasses, and among the vegetable remains a few elytra of beetles. All these have been referred by geologists to the same period. On communication of these particulars to the Geological Society last January, it was remarked that some of the plant-beds in Greenland are also interstratified with basalt; and Mr. David Forbes, who is an authority on such points, observed that the existence of leaf-beds in such a position might be regarded as affording grounds for belief in the non-igneous origin of basalt. On the other hand, he had made experiments on the non-conducting power of clay, and had found that even half-an-inch of clay was sufficient to protect vegetable forms from destruction by the heat of a mass of slag allowed to flow over them. This would, perhaps, account for the preservation of forms of trees under the lava of Vesuvius. We may expect to hear more of this interesting subject, seeing that the German and Swedish polar expeditions brought home large collections of fossil plants, which have yet to be described.—*Athenæum*.

COAL NEAR LONDON.

As far back as 1855 Mr. Godwin-Austen propounded the idea that the axis of the Ardennes in Belgium was the same as that of our Mendip Hills in Somerset, and that these two outcropping parts of a long line of elevation of old rocks were connected by an underground ridge of the same, hidden by the mass of overlying and unconformable secondary rocks. He suggested that "the depression of the Thames valley represents and is physically a continuation of that which, extending from Valenciennes by Douay, Bethune, Therouanne, and thence to Calais, includes the great coal trough of those countries." According to his view of past geological changes, it was argued by Mr. Godwin-Austen that we have strong *à priori* reasons for supposing that the course of a band of coal measures coincides with and may some day be reached along the line of the valley of the Thames, while some of the deeper-seated coal, as well as certain overlying and limited basins, may occur along and beneath some of the longitudinal folds of the Wealden denudation." The progress of geological knowledge since that period has by no means thrown discredit on these views. After Mr. Godwin-Austen had startled the scientific world with his propositions, the boring was made at Harwich, and Mr. Prestwich, who had previously been confident that the lower green sand was continuous under London, candidly acknowledged that he was at length constrained to

"adopt in great part" Mr. Godwin-Austen's hypothesis. We find Mr. Prestwich acknowledging the probability "that there is under the central part, at all events, of the London tertiary area a tract or ridge of the older rocks immediately underlying the chalk and gault, on different portions of which the three wells of Calais, London, and Harwich have touched; the one on the carboniferous series, the other on the new red sandstone, and the last on some slate rock." The idea of a connection between the Mendip Hills and the coal-fields of Belgium was also entertained by the late Sir H. T. De la Beche, in one of whose essays may be found the germ of Mr. Godwin-Austen's theory. As might be expected, the latter gentleman has appeared as a witness before the Royal Commission on the supply of coal. A very singular fact connected with this question transpired during the construction of the London, Chatham, and Dover Railway. While a tunnel was being excavated a few miles distant from Dover the workmen came upon a great mass of some black substance, which crossed the line of the tunnel in the very midst of the chalk. The engineers were obliged to cover up the exposed strata speedily, and the extraordinary discovery could not be made the subject of deliberate investigation; but a specimen of the substance was preserved, and is deposited, we believe, in the British Museum.—*Engineer*.

SO-CALLED "PETRIFIED HUMAN EYES" FROM PERU.

Dr. Spencer Cobbold, for the author (the Rev. Dr. A. Hume), has read to the British Association a paper on the discovery of what had been supposed to be Petrified Human Eyes, at Arica, in Peru. The region is exceedingly arid, and animal remains are not decayed, but dried, when put into the earth; and the communication stated that the corpses of Indians who had been buried before the Spaniards had landed were frequently to be found. In one part of Arica, near to where large numbers of people were known to be buried, a large number of eyes had been found. Some of these had been found near the corpses, and some, it was said, in the eye-holes of the skulls. A belief had prevailed that they were human eyes petrified; but on a collection of them being sent to Professor Owen, he pronounced them to be eyes of cuttle-fishes. Several were exhibited by Dr. Cobbold, and examined with much interest.

SOUTH AFRICAN DIAMONDS.

The magnificent Diamond, "the Star of Africa," variously valued at from 30,000*l*. to 40,000*l*., has been exhibited at Cape Town, where its purity and brilliancy have been acknowledged as unquestionable. It is about the size of an ordinary walnut, with an unspoiled surface, though irregular outline; but no flaw to detract from the value. At Cape Town, in one day, nearly 26*l*. was realised by the exhibition of this Diamond.

The following is an extract from a letter addressed by the Austrian Consul at Port Elizabeth to Professor Hochstetter, of Vienna:—"The Diamonds which have been discovered here are of extraordinary size and beauty; the territory in which they are found is upwards of 1,000 miles in extent. Every post brings news of the discovery of diamonds in various places, but they are most abundant at Likatlong, near the frontier of the Orange River Free State. Hitherto they have been found only on the surface; they vary in weight from half a carat to 150 carats. One found on my property was of the first water, in shape like an octahedron, and weighed 30½ carats; another of 46 carats was sold in London for 4,600*l*. The stone weighing 150 carats was broken, and a piece of 23½ carats is now in my possession. Herr Manch, who has gone up the Vaal River, is said to have discovered a diamond mine, which also contains granates, topazes, and other precious stones."

At Port Elizabeth, on Sept. 30, fifteen Diamonds were offered for sale on the Port Elizabeth produce market. Only four were, however, disposed of—viz., two diamonds of 1 1-16 carat, and two ditto ⅞ carat, for 5*l*. 15*s*.; 300*l*. was offered for six of the following weights:—13, 7¾, 3¼, 2 7-16, and ¼ carats, but refused; 75*l*. was offered for four diamonds of 7½, 3¾, 2⅞, and 2⅛ carats, but refused; 30*l*. was offered for the remaining stone of 3 7-16 carats, which was held back. On October 4th Messrs. A. Mosenthal and Co. offered for sale seven diamonds, varying in weight from 1⅝ to 5⅛ carats—comprising in the aggregate 18 5-16 carats. They were put up in one lot, and were declared not sold at 201*l*. They were all beautiful gems, of excellent quality and good shape.

In a paper read to the British Association on "Diamonds received from the Cape of Good Hope during the last Year," Prof. Tennant stated that a fine Cape diamond had been sold at Paris for 2,000*l*. Having noted the discovery of other diamonds, he said there was no country in the world that possessed a wider range of mineral wealth than Great Britain. With this fact the ignorance that existed of mineralogy was astonishing.

AUSTRALIAN DIAMONDS.

When the August mail left Australia there was some excitement as to the supposed discovery of a Monster Diamond in the New England district, New South Wales, by a Mr. Townsend. The weight of the stone was given as over 7 oz. It had been safely deposited in the Sydney Mint. The excitement about the discovery was prolonged for some days in consequence of certain difficulties which prevented the stone from being examined and tested after its arrival at the Mint. When these difficulties were removed, however, and the stone handed over to the Rev. W. B. Clarke, the eminent geologist, for examination, it turned out to

be merely a piece of rock crystal. The "monster diamond" was much talked of from the time its discovery was made known at Tamworth, New England district, until all doubts respecting its quality were set at rest. Several persons conceived the idea of forming a company for buying the stone while as yet it was lying unexamined at the Mint, being detained on account of a claim made by the Australian Steam Navigation Company for freight at the rate of one-eighth per cent. for carrying it, in the gold escort box, from Newcastle to Sydney. It was bought for 500*l.* on behalf of ten persons. Seven of the ten proprietors agreed to divide their tenth interest into scrip of ten each, and to sell five of each interest at 10*l.* each. There was a great run upon the shares, which soon went up to a premium. The formation of this company and the delay in the examination of the stone naturally tended to increase the excitement very much. Two or three days after the purchase of the stone the shareholders got delivery of it from the Mint by satisfying the claims of the company (5*l.*), and giving the Mint authorities an indemnity against all risk. The next stage was the application of tests, which proved the diamond to be a piece of crystal.—*Melbourne Argus*, Sept. 11.

According to the latest accounts an extensive area of ground has been taken up for diamond mining on the Cudgegong River, New South Wales, the only locality in that colony where diamond mining has as yet been prosecuted on a large scale. The Australian Diamond Company have provided themselves with a steam-engine for working their gem machinery. Fresh discoveries are continually reported, and Tarbet, Abercrombie goldfields, and the River Page are indicated as places whence precious stones have been received. Another diamond has been discovered recently at Sebastopol, Victoria; its weight is stated at three carats. Diamonds have been found along the greater extent of the Reedy Creek, at Eldorado, Sebastopol, Woolshed, and higher up at Wooragee. A gem found in the Epsom district was recently forwarded to Mr. Crisp, of Melbourne, who pronounced it to be a diamond; this is the first Bendigo diamond that has been heard of. A Lyttleton (New Zealand) journal states that a miner has brought a number of coloured crystals into Christchurch, and on inspection one stone, about half the size of a pea, was found to be a diamond, but it was so rough and jagged that its intrinsic value when worked up would be very trifling. As the finder declared that he knew where any quantity of this sand was to be found, it is thought that something better may be brought to light.

The following article upon the foregoing subject, from the *Times*, October 6, 1869, will be read with interest: The discovery of a diamond weighing three-quarters of a pound, and worth on a moderate estimate twenty millions of money, would be an event calculated to leave a mark even on this age of sensations. We only regret that we cannot quite announce it as a

fact. A stone, however, assumed to be precious, and defined in successive telegrams as a diamond, a topaz, and a nondescript, has actually been found in the Australian gem-sand. "The thing," as our Correspondent irreverently calls it, "is as big as a large lemon, it weighs between seven and eight ounces in the scale, and it might, as people say, be anything for all that could be told. To enable the reader to speculate on the possible marvel, and appreciate the phenomenon at its proper worth, we will just explain what it means, or would mean, if actually realised. Diamonds are measured by their weight in carats, a carat being four grains. The largest diamond of which we in this country have any practical knowledge is the famous Koh-i-noor, which in its historical shape, as shown at the Exhibition of 1851, weighed 186 carats, or 744 grains. The new Australian diamond would weigh about 900 carats, or 3,600 grains—just about five times as much. Diamonds, however, increase enormously in theoretical value with increase of weight; so that, whereas the Koh-i-noor was computed to be worth, according to the ascending scale of prices, some 2,000,000*l.*, the Australian stone would be valued by a jeweller at far more than five times that sum. We need hardly add that such calculations are purely speculative. It is all very well to prove the value of a diamond by the rates of a conventional table, but, as no purchasers could be found with millions in their pockets, the estimate is entirely nominal. The real value of a thing is what it will bring, and no stone could be actually sold for a million. In point of fact, this limitation of market values was very soon reached in the late buoyancy of the trade. Up to a certain point the value of diamonds rose greatly about twenty years ago, but when this point had been passed the prices remained stationary. The enhancement occurred solely in stones that, as the phrase goes, were 'everybody's money.' A diamond worth 500*l.* or even 1,000*l.* would fetch twenty or thirty per cent. in addition, but the famous Burgundy diamond, for instance, brought only 20,000*l.*—a very moderate price.

"It will certainly be interesting to learn by and by what this 'reputed' diamond turns out to be, but, as regards the mere possibilities of the case, we may remark that there is already a 'reputed' diamond in the world weighing actually twice as much as the Australian gem. This wonderful stone is, or was, in the Portuguese treasury, among the crown jewels of the kingdom, and it is known to weigh 1,880 carats. Unfortunately, that is about the amount of knowledge we possess in the case, for the Government would never allow it to be examined, and it may only be a white sapphire or something less. As soon as we come to ascertained facts the magnitude of the Australian discovery becomes manifest. It is certain there once was, and probably that there still is, a Golconda diamond weighing 280 carats. This stone was carried away from the treasures of the Great Mogul by Nadir Shah after the sack of Delhi in 1739, and in

the hoards of the Persian sovereigns it is believed still to be concealed. In the Exhibition of 1862 a diamond was shown which had weighed in the rough 254 carats, but this was a Brazilian stone of imperfect colour. A larger stone than either, known as the Mattam diamond, has but an apocryphal history, though there is probably truth at the bottom of it. Mattam is a principality in the isle of Borneo, and in the treasury of the Rajah this diamond is said to be preserved. An offer was once made by the Dutch Government of 50,000*l.* and a couple of gunboats for the gem, but refused; and as a superstition connects the fortunes of the Rajah family with the safety of the stone, and strangers are not permitted even to see it, the facts of the case are as yet unauthenticated. Enough, however, has been said to show what a marvel a real diamond of 900 carats' weight would actually be.

"Instinctively the colonists appear to have appreciated the wonder. First, a telegram from the mines announced the discovery, with the news that an armed escort was conveying the stone to Sydney to deposit it in the treasury; the next despatch reported that it had been placed in the Mint, and, further, that a banking company had advanced the very modest sum of 700*l.* on it at a venture. The remarkable thing, however, is that there should be any doubt about the real nature or quality of the gem. A well-known geologist, it is said, had been set to work upon it, but had not yet pronounced sentence. The fact is, that any pawnbroker's assistant could settle such a question in five minutes. To the eye of an expert the mere 'play' or 'fire' of a stone will disclose its quality, but, as the Australian gem is uncut, that evidence is not available. Two characteristics, however, of a diamond admit of easy and infallible test—its hardness and its specific gravity. Nothing but a diamond will scratch a diamond, whereas if the stone is only a white or yellow sapphire it may be scratched by a splinter of ruby. In this case, it would be a crystal of clay instead of a crystal of charcoal, and would still be very valuable; but if, as is probable, it is simple quartz, the miracle will disappear. Sufficient evidence, however, would remain to show that the Australian diamond mines may be rich in unknown treasures. Our correspondent himself had a stone in his hand, fresh from the diggings, which was a perfect specimen of diamond without speck or flaw, of five carats in weight. The value of such a stone in the London market would be 300*l.*, whereas it was sold on the spot for 112*l.* We are told, too, that diamonds—genuine diamonds—are on sale by women and children at every cottage, and there can hardly be a mistake, we should think, about the nature of the stones. At any rate, as some of the gems have now found their way to this country, the question of quality can soon be set at rest.

"It has been said that the art of manufacturing diamonds, like that of creating gold, might be no impossible invention, but that it would certainly be useless when accomplished. Exactly so it

may be presumed that diamonds will lose their value if they once come to be found by the bushel. All, however, depends on size and quality. Very small diamonds are already imported from Brazil in such quantities that at least two tons have found their way into the trade from the American mines. As far as the Australian discoveries are to be classed with these imports their effect will be trifling. If the number of larger or finer stones should prove to be limited, the increase of supply may perhaps stimulate the demand, and be attended with only a partial reduction of value. In point of fact, diamonds might easily fall some twenty or thirty per cent. in value and still be worth as much as they were thirty years since. It is clear, however, that the Australian colonists are carried away by the novelty of the discovery and the excitement of the idea. They are all dreaming of precious stones. At every table and in every railway carriage 'the talk is of diamonds and rubies, opals and emeralds, pearls and topazes,' and persons of all ranks are rushing to the mines. There is no reason why these mines should not, like the gold mines, have 'nuggets' of their own in the form of prodigious gems; but before we believe in a diamond as big as a man's fist we should certainly like to see it."

SIR WALTER RALEIGH'S EL DORADO.

DR. LE NEVE FOSTER has communicated to the British Association a paper on the Existence of Sir Walter Raleigh's El Dorado. The author advanced his own experience as acquired in a recent journey to the Caratal gold-mines of the Orinoco, as confirming the veracity of Sir Walter Raleigh, so coarsely impugned by the historian Hume, who says, "On his return Raleigh published an account of the country full of the grossest and most palpable lies that were ever attempted to be imposed on the credulity of mankind." Schomburgk, in defending Raleigh's statements, had, in his time, no positive evidence of the existence of gold in Venezuelan Guiana. The gold-mines which the author visited last year were discovered in 1849 by Dr. Louis Plassard, in the bed of the Yuruari, near the old Spanish Mission of Tupuquen. The Yuruari falls into the Yuruan, a tributary of the Cuyuni, which enters British Guiana, and eventually pours its waters into the Essequibo. In 1857 people began to flock to the place, and washed for gold in the river-bed, establishing the settlement of Caratal. The author had given the geological details of these mines in a paper recently read before the Geological Society. He maintained that the present Caratal gold-field was the one of which Raleigh heard such wonderful accounts. The "white spar" in Raleigh's detailed description was undoubtedly quartz; for spar is the name still used for quartz in Devon and Cornwall, and the author had himself seen outcrops of lode in Caratal where gold was visible in blocks of quartz rising up from the surface. There could be no mistake,

also, in identifying the locality,—"the Caroli," mentioned by Raleigh as the Caroni; for he mentions the falls, which are close to the point where the Caroni joins the Orinoco. The other details of locality and distance in Raleigh's account were shown by the author to agree closely with the facts that have now come to light.—*Athenæum.*

STRUCTURE OF PRECIOUS STONES.

Very few persons who admire or who deal in Precious Stones are acquainted with the intimate structure of these valuable minerals; and most persons will be astonished to learn that these bodies, apparently so solid and homogeneous, are often full of minute cavities, which, in general, enclose a liquid. The examination of this structure and of the included fluid must necessarily teach us much relating to the origin and formation of the minerals, and is, therefore, of great interest to us. Fortunately, the subject has been taken up by Mr. Sorby, who was fortunate in having the interesting collection of Mr. Butler placed in his hands for examination, and it is from a paper produced by these two gentlemen conjointly that we gather the following particulars. Sapphires, it would seem, in general contain fluid cavities. Sir David Brewster met with one no less than the third of an inch long, but our authors have seen none more than one-tenth of an inch in diameter. These are usually half filled with a mobile and highly expansible liquid, which, as will be seen further on, is considered to be liquid carbonic acid. Sapphires, as our readers well know, are composed of pure alumina, coloured, it is generally admitted, by a metallic oxide; but, according to Kühlmann, if we remember rightly, by some organic matter. Now, if it be clearly established that the enclosed liquid is carbonic acid, some light is thrown upon the chemical reactions and physical conditions by which the stone is formed. The ruby is also coloured alumina. Cavities, we are told, are far less numerous in these than in sapphires, and, moreover, they appear to contain only water or a saline solution. Occasionally, a liquid with similar characters to that observed in sapphires is seen, but not often; and we are thus led to suppose that the stone may be produced by different reactions and under different physical conditions.

The cavities in spinel, another form of alumina, are partly filled with a solid or very viscous liquid, and a colourless liquid of singular properties. It seems, says our author, to contract on the application of heat, and, in passing into vapour, must expand about 600 times less than when water passes into steam. No conjecture is offered as to what this liquid may be. Emeralds are often full of cavities which contain a liquid which does not expand when heated, and is apparently a strong aqueous saline solution. The emerald is a double silicate of alumina and glucina, and the liquid may be the mother liquor from which the

emerald has crystallised. Our conjecture is supported by the fact that the cavities also contain crystals, which dissolve on the application of heat, and recrystallise on cooling.

The diamond is, of course, the most interesting of all our precious stones, the origin and mode of formation of which has always been a great puzzle to chemists and mineralogists. Its structure has already been studied by Göppert, who discovered what he conceived to be organic remains, and hence infers that the diamond is the result of vegetable decomposition under peculiar conditions. Sir David Brewster first noticed fluid cavities in the diamond, and explained the optical peculiarities of some diamonds by their presence. Messrs. Sorby and Butler, however, show, that besides fluid cavities, diamonds sometimes enclose minute crystals of a different mineral, to which circumstance these owe their peculiar optical properties. In the diamond also, the enclosed liquid appears to be carbonic acid, as shown by its extraordinary expansibility. Only one other known liquid has anything like an equal rate of expansion, and that is nitrous oxide. The occurrence of this body in minerals is, it is said, highly improbable, and it seems, on the whole, that we may be justified in including liquid carbonic acid among natural liquid mineral substances.

The facts quoted show that ruby, sapphire, spinel, and emerald were formed at a moderately high temperature, at so great a pressure, that water could be present in the liquid state. The structure of the diamond does not afford positive evidence of a high temperature, while the absence of cavities containing water or saline solution does not prove that water was entirely absent. At the same time, the presence of what appears to be liquid carbonic acid seems to show that only a very little water could be present either as a liquid or as steam.—*Mechanics' Magazine.*

AUSTRALASIAN GOLD.

A COMPANY has been formed under the title of the Wairarapa Pioneer Prospecting Company, for the purpose of prospecting quartz reefs known to exist in the neighbourhood of the Wairarapa, New Zealand. A gold prospecting party sent up the Wanganui river, under the command of Captain M'Donnell, has reported the discovery of gold, and some specimens have since been brought into Wanganui. Gold is believed to exist in paying quantities at Terawiti, New Zealand; seven ounces of beautiful nuggety gold were obtained by Mr. Wright, of Ohiro, as the result of 15 days' work. At the last dates the Taranaki (New Zealand) Prospecting Company (Limited) was in course of formation; the capital is 500*l.*, in 100 shares of 5*l.* each. Attention is being directed to rich quartz reefs known to exist at Moonlight, New Zealand. Several rich nuggets have been obtained from Moonlight Creek; one of them, slightly impregnated with quartz, weighed 37 ounces. The gold was of a splendid

colour, and much like that met with in the Kingower and Mount Lorong districts, Victoria. It was found by a digger named M'Closkie. The Moonlight Creek diggings, it should be added, are in the province of Nelson. Prospecting has been proceeding of late upon Stewart's Island, New Zealand, but at present the results obtained can scarcely be said to be very satisfactory or conclusive. The yield of gold in Victoria for the first half of this year is estimated to be about 100,000 oz. short of the quantity obtained in the corresponding six months of 1868. In May and June, however, the yield was again increasing. The Ballarat alluvial mines still occupy the foremost place; as regards the quartz workings, those nearest Melbourne have presented the largest average yields. The total number of miners employed on the gold-fields of Victoria at the close of June was estimated at 9,890. A "rush" of considerable promise occurred in September in the parish of Kirkella, Victoria, in consequence of the discovery of two rich reefs—one called the Germania Reef, situated about one mile north-westward from the Bonnie Dundee Company's leased ground; and the other called the West Germania Reef, situated about half a mile further to the north-west than the first. The largest nugget ever yet found in Australia was disinterred in February, near Moliagul, in Victoria. It contained not less than 2,268 oz. of pure gold when cleaned; it was found within two inches of the surface by two Cornish miners, and it was named the "Welcome Stranger." Its value is computed at 9,534*l.* The next largest nugget on record was the "Welcome," exhumed from a depth of 180 ft. in June, 1858, and valued at 8,376*l.* The Spring Creek rush in Victoria—the latest feature in connection with Victorian gold mining—is considered to have proved a success; a population of upwards of 10,000 had accumulated in the locality at the last dates. The total amount of gold exported from Victoria to March 20, 1869, was 261,640 oz., of which 29,541 oz. were transhipped from New Zealand. During the corresponding period of 1868 the entire quantity exported was 387,011 oz., of which 31,332 oz. were transhipped from New Zealand. The principal gold-field in Queensland—Gympie—which in consequence of recent drought had been falling into rather a languishing state, had revived at the last dates, and some rich yields were reported. The Rockhampton district, although it does not yield gold in such a large proportion to a ton of quartz as Gympie, is yet considered a promising one, and its population is increasing. It is again reported that gold had been found in Tasmania; thus a payable quartz reef is stated to have been found at the base of the Tower Hill, ten miles from Fingal. The last fortnightly escort which had reached Dunedin, in the province of Otago, New Zealand, brought down 5,659 oz. of gold.

Of the Thames gold-fields (New Zealand), it may be remarked that the Ballarat and Clunes Quartz Mining Company has been pushing on its operations. The requisite machinery

has been ordered from Messrs. Langland and Co., of Melbourne, and is probably by this time in position. At the last dates the excavations were almost completed, and the necessary roads made, so that crushing was expected to be commenced in the course of March. In the province of Wellington, New Zealand, several parties have recently gone to the mouth of the Karori stream to prospect for gold. The Government of the province of Otago has offered a reward for further gold discoveries in that province. As regards the west coast of New Zealand, it may be noted that a nugget weighing 92 oz. was lately obtained on the banks of the Buller, near Lyell, where many nuggets were secured in 1864 and 1865. In the neighbourhood of Brighton and Charleston, in the same district, there is a considerable quantity of machinery employed, and in other places capital has been sunk to some extent, and is stated to be now receiving a liberal return.

The value of the Australasian gold imported into the United Kingdom in October was 613,487*l.*, as compared with 791,207*l.* in 1868, and 904,741*l.* in October, 1867; and in the ten months ending October 31, 1869, 6,556,436*l.*, as compared with 6,027,936*l.* in the corresponding period of 1868, and 4,768,711*l.* in the corresponding period of 1867. Quartz mining is exciting more and more attention in New South Wales, and reefs are being opened up in the colony in almost every direction—north, south, and west. Some rich reefs are reported to have been opened near the Old Major's Creek gold-field. On the Little River in the Braidwood district there has been a rich find of gold in the Homeward Bound claim on the Mosquito Reef; and it is now considered that the first plateau from the table land on the east coast of Australia from Bemgoria southward to the boundary of New South Wales is auriferous and more or less intersected by gold-bearing quartz reef. The total quantity of gold exported from Victoria to October 11, 1869, was 1,271,200 oz., of which 180,169 oz. were transhipped from New Zealand. In the corresponding period of 1868 the entire quantity exported was 1,551,213 oz., and of this total 183,644 oz. were from New Zealand. Satisfactory intelligence has been received from the Barossa gold-field in South Australia. About 2,200 oz. of gold from various South Australian diggings has been exhibited in Adelaide in the first week of October.

In the *Times*, Dec. 29, 1869, we read:—"The mining news brought from Victoria by this mail tells of some large yields. Among the ranges round Daylesford a party of miners obtained nearly 9 lbs. of gold from a lump of quartz not weighing much more. The *Inglewood Journal* reports the finding of a nugget weighing 200 oz., and a quartz specimen weighing 100 oz., which yielded 56 oz. of gold. This specimen was a round, much water-worn piece of quartz, like a large pebble, and three times the men attempted to use it in walling back the loose dirt in the claim they had thrown behind them; but every time it rolled

away, bringing with it the stones piled above it. The last time one of the men angrily threw it from him, with a curse upon its unhandy shape, but as it fell he caught the glisten of the metal, and on picking it up and washing away the mullock from it, the gold was seen thickly strewed all over it. The tables published with the mining surveyors' and registrars' reports state the total quantities of gold got from alluviums and quartz reefs throughout the auriferous districts of Victoria during the present year, up to Sept. 30, as follows:—From alluviums, 701,827 oz.; from quartz, 448,043 oz.; total, 1,149,870 oz. The total quantity exported during the same period, according to returns furnished by the customs department, is stated as 1,011,856 oz. of gold, the produce of this colony, being a falling off as compared with the first nine months of 1868 of 262,204 oz., a result which may be attributed principally, if not entirely, to the long drought during the first quarter of this year, and a lesser, but still in many places severely felt drought during the third quarter. Otherwise the depression experienced on some of the gold-fields, notably on Ballarat, appears to have been fully counterbalanced by the increasing importance of many of the others. The particulars given relative to quartz, quartz tailings, cement and mullock crushed, and pyrites and blanketings operated on during the last quarter show about the usual averages—viz., quartz, 10 dwt. 2·40 gr. of gold to the ton; quartz tailings, cement, &c., 3 dwt. 14·61 gr. to the ton; and pyrites and blanketings, 3 oz. 3 dwt. 12·27 gr. to the ton. The latter is an item which appears to increase every quarter, the quantity operated on, according to this return, being 412 tons, against 168 tons for the previous three months. The number of miners employed on the gold-fields of the colony of Victoria on Sept. 30 was 68,684, described as follows:—Alluvial Miners—Europeans, 34,996; Chinese, 16,307. Quartz Miners—Europeans, 17,295; Chinese, 86. Compared with the returns for June 30 last there is a decrease in the total number, amounting to 1,206—a result more apparent than real, since it is accounted for by the dispersion of the population at Spring Creek, in the mining division of Waranga South. The *Brisbane Courier* states that it is considered certain that the neighbourhood of the Gulf of Carpentaria will prove rich in gold."

NOVA SCOTIA GOLD-FIELDS.

A Correspondent writes to the *Mining Journal*:—"Your occasional comments upon Nova Scotia are beginning to direct the attention of European investors towards this long-neglected region, and inquiries have been made whether Gold Mining is really profitable here. It is only during the past three or four years that the business has been practised with any method, a majority of those who became interested preferring to extract gold from credulous buyers of land or shares to the more tedious

process of extracting the native metal from its encasing rock; but the following items will perhaps supply the information desired:—

"The Ophir Mine, at Renfrew, in three years, ending July, 1869, cleared 30,000*l.* profit, paying for its own purchase 12,000*l.* It produced 14,500 oz. within the above period.

"The Wellington Mine, at Sherbrooke, in thirty months, ending last August, produced 27,000*l.* worth of gold, at a cost, including the mine, of only 22,000*l.*

"The Palmerston Mine, also at Sherbrooke, yielded within the same period 20,000*l.*, and paid its own cost and a dividend of 25 per cent. within the first year.

"The Provincial Mine, at Wine Harbour, gave 30,000*l.* from 300 ft. of lead, worked only to a moderate depth.

"The Burkner Mine, at Waverley, in 1865, gave 35,000*l.* from 750 ft. of lead. The profit was 16,000*l.*, and might have been doubled through better economy, and a check upon gold stealing.

"The mine at Oldham, owned by the Boston and Nova Scotia Company, yielded 6,000*l.* in as many months.

"These are facts which have been officially attested, as mine owners have to swear to the produce when paying royalty. The three first-named properties are still productive, the latter has been closed on account of chicanery and litigation, and the rest being somewhat impoverished, are lying fallow for the present."

THE SUTHERLAND GOLD-FIELDS.

There has been read to the Geological Society "Notes on the Sutherland Gold-Fields," by the Rev. J. M. Joass; with an Introduction by Sir R. I. Murchison. Sir Roderick Murchison, in introducing the Rev. J. M. Joass to the meeting, called attention to the general geological structure of the counties of Sutherland and Ross, and especially to the circumstance that the summits of the mountains of that region are situated within a few miles of the western shore, forming a steep escarpment to the west and a long slope to the east, across which the disintegrated materials of the great mass of these mountains must have been conveyed (probably by floods carrying masses of ice) and deposited in the hollows of Eastern Sutherland. Of the rocks composing the mountains, Sir R. Murchison was inclined to regard the micaceous flags and schists overlying the lowest Silurian quartzites as the probable source of the Gold found in Sutherland, and he expressed an opinion that no considerable body of rock charged with rich auriferous bands would be discovered in the North Highlands.—*Athenæum.*

EARTHQUAKES IN THE PACIFIC.

A Correspondent, writing from Valparaiso on the 3rd of September, 1869, says:—"I arrived here on the 28th ult. in the steam-

ship *Payta*, from Callao. The people all along this coast, as far as Callao at all events, are in a state bordering on panic, caused by an announcement by one of the scientifics of Germany that on or about September 14, in consequence of the sun and moon being in closer proximity to our earth than usual, there will be a fearful Earthquake, accompanied by a tidal wave, which together are to destroy many ports on this coast, more especially in Callao and Arica. The latter has very little to lose, not having recovered from the devastation of last year. In the former port everybody appears to be on the *qui vive* for some extraordinary convulsion of nature, the majority of the inhabitants having removed their families to Lima or Chorillos, and the remainder, who can afford to do so, are arranging for flight. Arica,* from the sea, looks like a new colony of wooden and other frail buildings, nothing whatever having been left by the receding wave of last year but the United States gunboat *Wateree*, which sits as erect and comfortable as if on her natural element, while fully half a mile distant the Peruvian corvette *America* and a sailing vessel are breaking up. We left Arica on the morning of August 24, and about 1.20 p.m. (the *Payta* being two to two and a half miles distant from the land. 57 miles south of Arica, off Gorda Point, and in 75 fathoms of water) the vessel commenced to shake in the most awful manner.

"This terrific convulsed vibration continued for 45 or 50 seconds, during which time the sea presented the appearance of a heavy fall of large hailstones, sending up jets of water some eight or ten inches, and being about the same distance apart. The land, which rises perpendicularly at this point some 2,500 ft., presented an appearance that struck terror into the hearts of all on board; it visibly moved, huge masses of rock and earth being hurled into the sea, causing dense clouds of dust to rise, obscuring the coast northward as far as the eye could reach. The whole of the glass was thrown from the racks in the saloon and destroyed, while a great proportion of the earthenware on board shared the same fate. Happily the vessel suffered not the slightest injury, either in hull or machinery, which speaks volumes for the quality of materials and workmanship of which the Pacific Steamship Navigation Company's vessels are composed. Compass cards were deranged, and binnacles broken, and thermometers destroyed; what has been the result to the chronometers is not stated; happily they are not much required on this coast. The gangway ladders from spar to awning decks were shaken down, and grooves cut in the leaden weights of safety valves some half an inch deep, and the tubes clean swept. Such a convulsion had never before been experienced by any person on board, though some had been on the coast from 20 to 30 years. The opinion generally formed is that the *Payta* passed immediately over the crater of a submarine volcano at the moment of an eruption. Let the scientifics criticise my views as they please. Up to half-past 4 o'clock the same day we felt a suc-

cession of slight tremblings at intervals of only a few seconds. On arriving at Iquique, the same night, we learnt that two very severe shocks of earthquake had been felt there about 2 o'clock in the day. The inhabitants were filled with terror, and had all gone to the hills. At 2 o'clock next day we arrived at Cobija, where nothing whatever had been felt of the convulsions which I have endeavoured to relate in the foregoing narrative, if such it may be called, and the feeling is that in all probability Arica and other places in the north of Peru may have been visited by some very fearful calamity. Under the circumstances, as you may imagine, business is not very brisk, nor is there any probability of improvement until the time appointed for the 'terrible devastation' be passed. I hope the prophet may prove to be false. To my friends in Peru I would say with all sincerity, 'Dios guarde á Vds. muchos años!'"—*Liverpool Albion.*

EARTHQUAKE IN INDIA.

A FRIEND writes from Asaloo, under date of January 26, 1869:—"We were thrown out of our wonted serenity and sense of security on the 10th by one of the most terrible Earthquakes I, or many others in India, have ever witnessed. This neighbourhood was the very centre of the convulsion; for from the evidence I have collected it spread out from an area about twelve miles west of this, in every direction. Silchar went down, every *puhka* house in the place, church and all; the pale of the bazaar sank several feet, trees that were on a level with the main street sank so much that their tops were afterwards on the level. One village was sent up in the air, and sank again, leaving it on a slope, and a low range of low hills with broken tops was formed, with deep chasms between them; sand, with water (hot), came up in cones in several places. Here it was quite appalling: the motion so great that most people sat down on the ground. I just managed to keep my feet, but then kept staggering about from the jerking side to side movement that accompanied the waves of motion. It went off from here eastward. All is forest round our head-quarters, so that the motion could be followed by the wild way in which the trees were lunged about. The sudden way it overtook us was as bad as anything. No preparatory rumble ushered it in. Shocks continued, two and three every day, up to the 21st: one or two of these were peculiar, from the direct upward jumps they gave, just as if some one gave one's chair a heavy blow immediately from below. On one occasion two thumps occurred at an interval of twenty seconds. Such an earthquake has not been felt for an age in these parts; but the area is one of terrible convulsions in past ages—just at the re-entering angle of the mountain ranges, where a range striking east and west suddenly meets another with an almost north and south one. Wongong has suffered a good deal, and it has been noticed as far up into the Gangetic Delta as Morglyr. Calcutta, as you will know ere this reaches you, got a smart shock."—*Athenæum.*

VESUVIUS.

PROFESSOR PHILLIPS, of Oxford, has delivered at Exeter a lecture on Vesuvius, in which he attributed the cause of Volcanic Eruptions to the action of steam raised to great power proportionately to the depth at which it was formed. Taking the assumed increase of the earth's temperature with the increase of depth from the surface, he regarded the limit of twenty miles as equal to producing sufficient heat to raise steam to the pressure of 40,000 atmospheres; or it may be said, in other words, that at thirteen miles depth the earth's internal temperature would be equal to raising steam of a force sufficient to support a column of lava thirteen miles high. The intermittent nature of eruptions was explained by the action of the artificial Geyser, produced for lecture illustration by Professor Tyndall. The lecturer was highly applauded.

THE WESTERN WORLD.

THE completion of railroads across America, from the Atlantic to the Pacific, makes Americans calculate on a number of travellers to visit the wonders of that which is still a new world. One of the grandest sights on the Pacific side is declared to be the valley of the Yosemite, in the Sierra range, about 250 miles east of San Francisco. The first time a white man ever entered it was in 1848, and even now the journey is "somewhat hard." The route from San Francisco is by way of Stockton, a town 110 miles due east, and this part of the journey is done by river steamer, the next 100 miles by stages, and the last 43 by saddle-horses, which in two days, the riders camping in the woods for the night, bring the travellers to Inspiration Point, where the whole magnificence of the Yosemite bursts upon the view. The valley is ten miles long and three wide. Its sides are granite walls from 2,000 ft. to 4,500 ft. high. Great domes and pyramids rise above the deep hollow, at the bottom of which is a little lake and stream. A small river, 70 ft. wide, tumbles over on one side of the immense height, coming down in three falls, the first of them 1,300 ft. In the valley are nooks and bits of scenery of rare beauty, contrasting almost strangely with the solemn grandeur of the surrounding walls and peaks. The spot is more than a place for summer resort, it is one of the wonders of creation. It is boasted that no one ever made the trip and returned disappointed. At Stockton the tourist may turn aside, and a ride of 72 miles will bring him to the Calaveras grove of big trees. There are 92 trees, ranging in height from 150 ft. to 327 ft., and from 10 ft. to 30 ft. in diameter. Their age is supposed to be from 1,200 to 2,500 years. There is another grove, only six miles from Mariposa, on the Yosemite route, containing 427 trees, the largest 34 ft. in diameter. The Geysers are another wonder of California. They are about 60 miles north of San Francisco. Hundreds of springs, of all

kinds, colours, and temperatures are to be seen, with immense deposits of sulphur, alum, magnesia, epsom salts, and other minerals. The puffing and roaring of the steam which issues from every crevice in the rocks, and rushes with great violence from "Steamboat Springs," the dashing and surging of black boiling water in the unfathomable depths of the "Witches' Cauldron," and the sulphurous fumes which fill the air, produce an indescribable effect on the beholder.

LAKE NIPIGON.

During the summer good work appears to have been done by the Geological Survey in the Lake Superior region. Professor Bell's party have all returned to their winter quarters, after having experienced many of the hardships and privations incident to the life of the first explorers in the distant wilderness. We understand that the results of the expedition include a complete topographical and geological survey of Lake Nipigon, and an exploration of much of the surrounding country. This lake, it appears, will rank in point of size with the other great lakes of the St. Lawrence, forming the sixth and last in the chain. Professor Bell has not yet been able to map the whole of his extensive survey, but thinks the area of Lake Nipigon will be found to exceed that of Lake Ontario, or even Lake Erie, some 500 miles or more of coast line having been traversed. This great lake is drained by the Nipigon River, or upward continuation of the St. Lawrence beyond Lake Superior, which is described as a very large clear-water stream, about 30 miles in length. Upwards of a dozen rivers of considerable size are reported to empty into Lake Nipigon from all sides. We understand that one of the most singular features in the geography of this beautiful lake is the immense quantity of islands which are scattered throughout its whole extent, and presenting a great variety in size, form, and elevation. It appears that geological discoveries of a highly interesting and important nature have been made, and that, contrary to common belief, a large extent of level land with deep and fertile soil exists in the Nipigon country. Professor Bell had received instructions in addition to his geological explorations to obtain as much information as possible in regard to a route to our great western territory, and his discoveries in this direction are perhaps not the least important of the results of the expedition. If we are not mistaken, he has found that this country, so far from being a difficult one, offers great facilities for railway construction. Further, he has, we believe, ascertained that the elevation of Lake Nipigon above Luke Superior is very moderate, and consequently this lake may be found useful for the purpose of navigation in the desired direction. It will, of course, require considerable time to elaborate for publication all the geological data obtained upon this survey, but it is to be hoped that a special

report on the engineering capabilities of the country will be obtained as soon as possible, since it is so desirable to have all the information available before finally adopting any route.—*Toronto Globe.*

FOSSIL BOTANY.—CRYPTOGAMIC FORMS OF THE COAL PERIOD.

Mr. W. Carruthers has read to the Royal Institution a paper on this very interesting question, of which the following is a synoptical view:—

The student of Fossil Botany encounters greater difficulties in his efforts to restore the vegetation of former epochs in the earth's history than those which beset the labours of the comparative anatomist in his restoration of extinct animals. These difficulties arise chiefly from two causes: First, the absence in the vegetable kingdom of a substance which would resist decay like the solid skeleton found in all the vertebrate, and in many of the invertebrate members of the animal kingdom, causes the fragments of plants which have escaped decomposition to be preserved much less perfectly than the remains of animals. Carbonaceous stains or amorphous casts are the most frequent indications of the former vegetation of the globe; specimens exhibiting structure are comparatively rare; and it is such specimens only that give certain evidence of the nature and affinities of the organisms to which they belong.

The other serious source of difficulty arises from the fact that no relative proportions exist among the different parts of a vegetable individual. The size of the leaf, the flower, or the fruit, can give no indication of the size of the plant. Indeed, these are more frequently found large in humble plants which never rise above the surface of the ground than in large trees. And this is true, not only in the general, but even among members of the same natural group; where great differences exist in the size of the individuals, no corresponding differences are to be found in the parts of which they are composed. Thus the foliage and fruit of our only indigenous pine—the Scotch fir—are greater than those of the mammoth *Wellingtonia* of California; and the fruit of the small willow (*Salix herbacea*, L.), which covers with a dense carpet the summits of some of the higher mountains of Scotland, is as large as that of the huge willows which ornament the margins of our English rivers. On the other hand, the different parts of an animal possess such relations to each other in size, form, and structure that a zoologist has not so difficult a task before him in restoring, even from imperfect materials, the general aspect of an extinct animal.

Thus the progress of Fossil Botany has been necessarily slow, and great diversity of opinion exists as to the systematic position of Fossil Plants. Nevertheless, the accumulation of observations and the preservation of instructive specimens are now supplying the means of dealing with the subject, and recent important advances have been made in uniting separate fragments (roots

and stems, leaves and fruit) hitherto described under different names and placed in different genera. In regard to the vegetation of the coal period, Mr. Carruthers said that little information has been obtained, since in the carbonised remains of the plants the structure is almost wholly obliterated. The best preserved plants occur in the beds of shale accompanying the coal, or are obtained from earthy nodules in the coal itself, which injure its market value, and are cast aside by the miners. Before comparing these fragments he gave a rapid glance at the place their modern representatives occupy in the vegetable kingdom and the more important peculiarities of their structure; and, referring to large diagrams, pointed out the characteristics of phanerogams (with flowers, seeds, and stems exogenous or endogenous) and cryptogams (without flowers, having spores and stems acrogenous or thallogens). Vascular cryptogams (all acrogens) are ferns, horsetails, club mosses, and pillworts; cellular cryptogams are mosses, lichens, fungi, and algæ. After stating that the chief plants of the coal formation were ferns (*filices*), horsetails (*equisetaceæ*), and club mosses (*lycopodaceæ*), Mr. Carruthers considered at some length the chief peculiarities of ancient and modern specimens of each (including the pteris, selaginella, isoëtes, calamites, lepidodendron, sigillaria, and stigmaria), giving cogent reasons, partially derived from microscopic observation, for grouping together certain small plants (like the marestail of our ponds) with fossil trees of from 40 ft. to 70 ft. high. In concluding, he said that the plants he had been describing are held to be types of the plants to which we owe our stores of fuel. They grew on extensive level plains, their fleshy roots penetrating the soft mud of the surface soil. The moist atmosphere encouraged the growth of cellular parasites and epiphytes, and the aroid discovered by Dr. Paterson, with several species of antholithes, most probably represents epiphytes of a much higher organisation which flourished on the sigillarias. Coniferous trees sometimes grew on the margin of the plains, but their proper habitat seems to have been the higher ground, from which an occasional stem was floated down by running water to the plains below. What plants were associated with the conifers in their upland regions is as yet quite unknown, and the flora of the coal period at present ascertained is that of the plains. And this is of high interest, apart from its economic value, from its revealing to the biologist an assemblage of plants agreeing in all essentials with some of the humbler members of our present flora, but attaining at so early a geological period a development not only in size but in organisation greatly in advance of their modern allies.—(*See the Report, in extenso, with diagrams,* 11*pp. in the Proceedings of the Royal Institution.*)

WELL FOUNDATIONS.

The following paper, descriptive of these operations, has been read to the Institution of Civil Engineers. The first paper read

was on Sinking Wells for the Foundations of the Piers of the Bridge over the river Jumna, Delhi Railway, by Mr. Imrie Bell. After alluding to the native plans of sinking wells, built of masonry or brickwork, by excavating the sand from the interior, at first by means of a spade, called a "phaōra," and after the first 5 ft. by an implement called a "jham," reference was made to a modification in the use of the "jham" in constructing the railway bridge over the Jumna, at Allahabad, where, instead of sending down a diver to force the spade into the ground, a pole was employed to strike the butt end of the "jham" and so to drive it into the ground. This was, in the author's opinion, a decided improvement; but the process was still tedious and slow, especially where clay or hard strata were met with.

The author then proceeded to describe the mode of forming the foundations of the bridge over the river Jumna, near Sirsawa, on the Delhi Railway. It appeared that the bed of the river at this point consisted of coarse and fine gravel and sand, interspersed with layers of blue clay, 3 ft. and 4 ft. thick, and covered with silt; but during the rainy seasons large boulders, weighing 14 lbs. each and upwards, were brought down, and deposited by the scour of the river 30 ft. below the level of the bed. The bridge comprised twenty-four openings, each 99 ft. in the clear, and the superstructure was composed of two lines of lattice girders, resting on brick columns, or wells, each 12 ft. 6 in. external diameter, and 5 ft. 10 in. internal diameter, so that the wall of the well was 3 ft. 4 in. thick. In some instances, the sites of the piers were got clear of water by diverting the river at different points during the dry season, while in other cases islands were formed, by driving a half-circle of piles on the up-stream side, then lowering sand bags on the down-stream side to the height of 4 ft. or 5 ft., and afterwards filling up with sand to 5 ft. above low water. The curb on which the steining of the well rested was formed of wrought-iron plates and angle irons riveted together; and in cross section the curb was like an inverted right-angle triangle, of which the height was 4 ft., and the base 3 ft. 4 in. When each curb was complete, it was moved into position, and the compartments were then filled in with concrete. The curb was next sunk by men working with the "phaōra" and basket, till the upper edge was within 3 in. of the level of the water, when a ring of brickwork was carried up for a height of 6 ft. The excavation of the interior was again proceeded with, by means of the "jham" and divers in the old native style; afterwards a further height of 10 ft. of brickwork was added, but the material was now removed by a sand-pump (to be hereafter described) worked by a steam hoist of 4-horse power, as was the case after two additional lengths, each of 15 ft., were built, when the well was carried down to its full depth. In operations of this nature, great care was necessary, especially at first, to insure the well, or cylinder, descending vertically. For this purpose, the curb should invariably be sunk alone with-

out any building. The first height of brickwork should not exceed 5 ft. or 6 ft., the next 10 ft., and it was never advisable to build more than 15 ft. at a time. Before commencing any additional height, the top course of the brickwork already built ought to be removed, to insure a thoroughly clean surface for the mortar.

The lime used at the works was made from marl, or, more properly speaking, calcareous clay, which, while soft, was roughly moulded into bricks. These were stacked to dry for three or four days, and were afterwards burnt with wood in kilns for fifty or sixty hours. The flues were then closed with bricks and mud, and so allowed to remain for two or three days. On the kiln being opened, the lime brick were unloaded almost in a whole state, were ground under stones, screened, and carried to the works pure and free from ash or dirt. The mortar was made from one part of ground lime and one part of clear, sharp sand. This mortar was used in all the well foundations of the bridge up to the level of low water; and as a proof of its quality it was stated that it was easier to break the work as a mass than to separate it at the joints or beds. Above the level of low water, the mortar was composed of white hill lime, and soorkhee, or crushed brickbats, in equal proportions, as it was found that the lime from the calcareous clay lost the greater part of its cohesion when used in work exposed to the vicissitudes of the atmosphere; whether this arose from the frequent changes from dryness to humidity, or from heat or cold, was not ascertained.

The well sinking for the foundations of the piers and the abutments of this bridge was completed in little more than two years, which, without deducting any time for building up the brickwork, or for that unavoidably lost by the rise in the river during rains, gave an average rate of 159 ft. per month. The time occupied in the building of the steining of the wells, erecting, taking down, and re-erecting scaffolding and staging for sand pump, weighing the wells, &c., was equal to that employed in sinking. This would give the rate of sinking as a little over 300 ft. per month. If cast-iron cylinders had been used, the work could have been performed much more quickly, as the portions of the cylinders could have been put together more rapidly, and owing to the slight bearing surface exposed by the thickness of the iron, compared to the breadth of the brickwork in the walls of the well. The total weight of the foundations and of the iron girder superstructure on each well was 420 tons, and the area of the bottom of each well was 117 ft., so that the weight was less than 4 tons per square foot.

The novelty in the sinking of the wells of this bridge was in the use of the sand pump. This was described to consist of a wrought-iron cylinder having a pump riveted to it at the top, in which was a piston fitting loosely, and pierced with small holes to allow of the escape of water. The piston-rod terminated in

an eye at the upper end, to which a chain could be attached. The bottom of the cylinder was moveable, and in the centre there was an upright suction pipe, projecting outwards for a distance equal to its own diameter, and inwards nearly to the top of the cylinder. When the pump was lowered to the bottom of the well, the chain attached to the piston-rod was worked up and down like a ringing engine. In this way water was first drawn through the upright pipe, followed by sand or other material, which fell over the pipe into the cylinder. This operation was continued until the cylinder was quite full, which was known by the piston working stiffly, when the machine was raised to the surface; the bottom of the cylinder was then detached, with the column of sand resting on it, and another cylinder bottom which had been cleared of its sand was substituted. The number of men employed at each well was fourteen; nine working the chain, two clearing away the stuff brought up by the pump, one in charge of a steam hoist, one breaking firewood, and an overseer. The average rate of sinking, including contingencies, was about 6 ft. in eight hours. This rate was extraordinary when compared with the old system of the "jham" and diver, and would, it was believed, materially reduce the expense of bridge work in India.

In conclusion, reference was made to other methods adopted in this country for sinking cylinders; particularly to a machine on the dredger principle, which had been used in the construction of the new bridge over the Clyde, at Glasgow, and to the excavator which had been employed in sinking the cast-iron cylinders for the foundations of the piers of a railway bridge over the same river, and which formed the subject of a separate paper. On considering the different plans, the author stated that he thought most favourably of the sand pump of Mr. Howard Kennard (Assoc. Inst. C.E.), as from its simplicity it was peculiarly adapted for India and for localities where skilled labour could not readily be procured. Some improvements which had been effected in the details were then described, particularly in the substitution of the moveable bottom for the side-doors as originally made, and in adapting the pump for piercing clay at the Sutlej Bridge Works.

The second paper read was a description of Apparatus for Excavating the Interior of, and for Sinking, Iron Cylinders, by Mr. John Milroy. It was believed that, for the purpose of sinking cylinders, the great desideratum hitherto had been some method of excavating the earth from the interior without at the same time having to take out the water, and to keep it out during the operations. This object seemed to the author to have been attained by a machine of his invention, which was used in the construction of the bridge over the Clyde (City) Union Railway, to which Mr. Fowler (past president Inst. C.E.) and Mr. Blair (M. Inst. C.E.) were the engineers. This machine will be found fully described and illustrated in the *Mechanics' Magazine* for May 22, 1868.

The excavating apparatus, commonly called the "excavator," was thus described:—It consisted of a horizontal frame of iron, with an outside rim 9 in. in height, to which radiated, like the spokes of a wheel, T-irons from a small cast-iron ring in the centre. To the bottom of the outside rim were hinged eight heavy iron spades, which, when drawn in, fitted closely, with their points pressing against the inner ring. The hinges of the spades were so constructed as to prevent them from turning back beyond the perpendicular. The whole apparatus was very strongly made, and it formed when closed a nearly water-tight tray. When the machine was descending, the spades were allowed to hang vertically, and they were forced into the ground by the aid of two chains fastened to the top of upright arms on opposite sides of the excavator, then passed down the cylinder, under a pulley, up between two leaders, and over another pulley, the end of each chain being wound round the large axle of a capstan or drum on the landing stage. These chains were calculated when tightened to keep the machine down whilst the spades were being drawn in through the ground and up to the frame. This was effected by a second set of chains, all of equal length, and each fastened at one end to the inside of a spade, and at the other to the end of a main chain, by which the machine was raised to the surface with the earth it contained by means of a steam hoist. In order to enable an opinion to be formed of the capabilities of the excavator, it was mentioned that the progress of the excavation, and the corresponding subsidence of the cylinder, reached from about 12 ft. to 20 ft. per day of ten hours, inclusive of the time employed in adding fresh lengths of cylinder, putting on weights, &c. When there had been little interruption for any of these purposes, it had amounted to 25 ft. in the ten hours, and then the average quantity of sand brought up at each lift was 21 cubic feet, and the total quantity during the day was found by measurement to be 70 cubic yards. Twelve men in all were employed, viz., one engineer, one stoker, six men working the drums, three attending to the loading and discharging of the excavator, and one man wheeling away the materials.

In conclusion, the following advantages were claimed for this apparatus:—First, that it was perfectly independent of water, which was allowed to remain in the pit or cylinder until the excavation was completed; secondly, that it could be used, and was equally effective, at any depth, without sensible difference in the cost of working; thirdly, that its rate both of sinking and of excavating was higher than had yet been attained by any other method; and lastly, that it was not liable to get out of order, whilst its action was always in the same perpendicular line, and the expense attending its working was comparatively trifling, as skilled workmen were not required.

BUILDING STONES.

A PAPER has been read to the Civil and Mechanical Engineers' Society by Mr. Arthur C. Pain, on "The Principal Building Stones used in the Metropolis." The author confined the subject of his paper to the building stones proper, excluding paving stones and granites. It was illustrated with a map of England and Wales, showing the position and distance of the various quarries, and their means of communication with the metropolis by railway or sea. There was also a table giving the name of each, the county, name of owner, and agent in London; also the mineral and geological designation, component parts of stone, weight, chemical analysis, number of feet to the ton, average size of blocks, suitability for various purposes, the cost of working, colour, mode of working, price at quarry and at the various termini in London, as well as a few of the principal buildings in the metropolis and country constructed of each stone, with remarks on the beds, &c. The author then described chronologically as they came into use, the Kentish Rag, Gatton Fire Stone, Caen, Purbeck, Portland, Bath, Painswick, Bramley Fall, Mansfield, Chilmark, Ancaster, and Doulting. Specimens of each bed were exhibited from the quarries of Messrs. W. H. Bensted and Sons, of Maidstone; Mr. W. Carruthers, of Gatton; Mr. E. Foucard, of London and Caen; Mr. W. H. P. Weston and the Portland Stone Company, both of Portland; Messrs. Randell and Saunders, of Corsham; and Messrs. Pictor and Sons, of Box; Messrs. Husler and Co., of Headingley: Mr. Robert Lindley and Messrs. S. Fisher and Sons, both of Mansfield; the Wardour, Chilmark, and Tisbury Stone Company (Limited), of Tisbury and London; the Ancaster Stone Quarries Company, of Ancaster; and Mr. C. Trask, of Doulting; all of which have been used extensively in London. He also brought before the notice of the Society, and exhibited, specimens of the Hollington, Little Casterton, Clipsham, Forest of Dean, and Minera.

The decay of stone, its cause and prevention, having particular reference to London, was next considered. The decay, the author believed, was caused by bad selection. As a proof of this, he drew the attention of the meeting to the fact that nearly all the principal buildings in the immediate neighbourhood of each quarry were in an excellent state of preservation, while buildings in London of the same stone which had been comparatively recently built were more or less in a state of decay. He attributed this, firstly, to the fact that the masons who worked the stone for the local buildings understood the material, and knew which quarries and beds were good, and rejected the bad; while the masons who worked the stone for the London buildings knew very often nothing about it, and put in good and bad without proper selection: secondly, the architect and engineer, in his multifarious duties, could not afford the time to study each different class of stone at the quarries, so that the specifications

were very often loosely worded, of which advantage was constantly taken. He did not wish to throw blame on them, as there was no place where detail or reliable information could be obtained. The author then gave as a proof of the difficulty of obtaining information that he had devoted all his spare time for over six months in getting the results which he had laid before the society that evening, notwithstanding that the respective quarry owners and the officers of the Geological Museum and Mining Record Office had afforded him every facility.

He then pointed out to the meeting how much this country was behind France in these matters, for M. Michelot, Chief Engineer of Roads and Bridges, had recently made a report, by the direction of the French Government, on the building materials of that country, giving very detailed information, while the only works we had on the subject were the Commissioners' Report, 1839, which treated generally and not in sufficient detail a few of the principal freestone quarries, leaving out hundreds of important quarries, notwithstanding which, to prove how much a work of this kind is wanted, the report originally published at 6*d.* is now worth from 10*s.* to 1*l.* The specimens of building stones at the Geological Museum was a step in the right direction, but the information concerning them was meagre in most cases, and in some *nil*; besides which, it was easier to judge of the quality of a stone if the specimen was a rough lump than if squared and faced up. The "Mineral Statistics," Part II., for 1858, published by the Mining Record Office, was a very valuable work, but it did not go deeply enough into the subject to be of great use for professional men. In conclusion, the author considered that until the heads of the professions of architecture and civil engineering, and the trades connected with the same, took the question up, and appointed an architect, engineer, chemist, geologist, builder, and practical stonemason, and an appointment of the same by the Government as Royal Commissioners, to report fully and collect specimens from all the principal quarries in the United Kingdom, to be put in the public museums in every large town, we should still see the stonework of our public and private structures decaying away from want of proper knowledge of the subject.—*Mechanics' Magazine.*

Astronomy and Meteorology.

PROGRESS OF ASTRONOMY.

Among the various branches of physical science, Astronomy occupies in many respects a foremost rank. Newton's great discovery of universal gravitation raised it from the rank of a science of observation to that of one admitting of the most exact mathematical deductions; and the investigation of the consequences of this law, and the explanation thereby of the lunar and planetary disturbances, have afforded a field for the exercise of the highest mathematical powers on the part of Newton and his successors. Gradually the apparent anomalies, as they might have been deemed, in the motion of the heavenly bodies were shown to be necessary consequences of the one fundamental law; and at last, as the result of calculations of enormous labour, tables were constructed enabling the places of those bodies at any given time to be determined years beforehand with astonishing precision.

A still more striking step was taken. When it had been shown by careful calculation that the apparent motion of the remotest of the planets then known to belong to our system could not be wholly explained on the theory of gravitation, by taking account of the disturbing powers of the other known planets, Adams in our own country, and Le Verrier in France, boldly reversed the problem; and, instead of determining the disturbing effect of a known planet, set themselves to inquire what must be the mass and orbit of an unknown planet which shall be capable of producing by its disturbing force the unexplained deviations in the position of Uranus from its calculated place. The result of these inquiries is too well known to require notice.—*Proceedings of the British Association.—Inaugural Address.*

CHANGES IN THE HEAVENS.

Professor Grant, in the third of his lectures on Stellar Astronomy, delivered at the Royal Institution, after noticing the evidences of perpetual change on the surface of the earth and in the animal and vegetable kingdoms, he proceeded to consider the question, Are the heavens exempted from this great law? As convincing evidence that changes are really taking place in the heavenly bodies, Professor Grant commented at some length on the facts that certain stars have entirely vanished from our sight; that new stars have appeared; that many stars vary in brightness, some regularly at stated intervals, and others quite irregularly; and that some stars change their colour; and he referred to examples given in ancient records and modern observations. Among others, the Professor especially referred to the very bright star in Cassiopœia, observed by Tycho Brahe in 1572, which, after diminishing in brightness and varying in colour, finally disappeared in March, 1574; and to the very bright star which appeared in Corona Borealis, in 1866, and

which is still visible with greatly diminished lustre. The Professor next alluded to the sun itself as a variable star, and after referring to its physical constitution—a dark central glowing mass inclosed in luminous gaseous envelopes—commented on the black spots on its disc, now attributed to great rents in these envelopes. He then said that as the revelations of the spectroscope have proved that the chemical constitution of the stars resemble that of the sun, it is highly probable that their variability in brightness and colour is equally due to the operation of the same physical laws manifested in the solar phenomena, and which are effecting such great transformations in our own globe.

POWER FROM THE SUN'S RAYS.

MR. BALDWIN, of New Jersey, has published a pamphlet on the means of obtaining power without fuel, a subject which has for some time been attracting attention. Of Ericsson's project for obtaining Power from the Sun's Rays, the details of the apparatus by which the problem is to be worked out have not yet been revealed. Many years ago Sir Humphry Davy suggested liquid carbonic acid and other similar fluids as media by which the waste heat of a steam-engine might be converted into power; and there is no doubt that the sun's rays, collected by mirrors on a vessel containing such a fluid, which afterwards passed into a similar vessel, kept cool by external evaporation or otherwise, would generate a sufficient difference of pressure to enable an efficient motor to be obtained from the arrangement. In India, where there is a blazing sun throughout the greater part of the year, such an engine would be very valuable for moving punkahs, and for raising water for domestic purposes; and sufficient water could be raised to a tank upon the roof of the house during the day to keep the punkahs in action during the night by the descent of the water through any instrument that generated power.—*Illustrated London News.*

ON THE MODES OF DETERMINING THE COMPOSITION OF THE SUN AND OTHER HEAVENLY BODIES BY THE SPECTRUM OF LIGHT. BY PROFESSOR MILLER.

IT is only three years since the Council of the British Association wisely adopted the plan of still further connecting themselves with the general public by nominating the chief amongst scientific men to give lectures to working men. Professor Tyndall addressed those at Dundee, Professor Huxley the men of Norwich last year, and Professor Miller was appointed to lecture to the working men of Exeter. Professor Miller, in commencing his lecture, which was a series of experimental illustrations of the Modes of Determining the Composition of the Sun and other Heavenly Bodies by means of the Spectrum Analysis, gave a general account of the modes by which many minerals and metals testified their presence. He then gave a few ordinary

chemical illustrations of the manner with which the old system of tests was applied, and commented on the delicacy with which they could now be conducted, some metals manifesting themselves in such infinitely small quantities as less than a millionth part of a grain. After giving a general idea of the law of vibration of musical notes, which were illustrated on the screen as curves caused by a tuning fork, the learned Professor said that everything, solid and liquid, when white hot gives out a spectrum. They could be converted into vapour, and that vapour told its own tale when the light was decomposed into the banded colours. Several beautiful experiments were then given, the white screen being crossed, after the gas lights were lowered, by a large and beautiful spectrum showing the three primary and the secondary colours. Silver was then vaporised, and its beautiful green lines at once manifested themselves as so many bands crossing the red end. The spectra of copper, iron, and manganese followed, and the green, red, orange, blue, and other coloured bands were equally visible. The spectrum of manganese was especially beautiful and brilliant.

The learned Professor then explained that these coloured bands of light were due to vibration among the particles of the vaporised metals. When solar light was thrown on a screen, he stated that, instead of coloured lines or bands, black or very dark ones made their appearance. They were first noticed by Dr. Wollaston, and afterwards by a German optician, named Frauenhofer, who found them so plentifully that they were named after him. A few years ago, Kirchoff discovered there were several thousands, and actually mapped out their relative places. How was it that in an artificial spectrum produced by the oxy-hydrogen flame there were coloured bands, whilst in the solar spectrum they were all dark? Simply this, that the light of any burning metal when it passed through vapour of the same was absorbed. This was illustrated by first showing the bright yellow spectrum of common salt or chloride of sodium, and then passing the light through a lamp that was filled by sodium vapour. The dark band immediately made its appearance on the screen. Professor Miller then explained the structure of the spectroscope as being simply a telescope through which to look at prisms fixed near the further end. By intensifying the telescopic power, the fine dark or coloured lines could be seen in all their abundance. The photograph of the solar spectrum was then thrown on the screen, and its crowd of varying thin and thick dark lines could be seen traversing its entire length. By passing an electric spark through a prism, alongside with solar light, both the dark and coloured bands could be seen at the same time. This proved that the sun contained certain metals, as iron, copper, manganese, calcium, &c. The glowing body of the sun shone through an exterior atmosphere, wherein were floating vaporised metals, and these absorbed the light, and caused the dark lines in the solar spectrum.

The Professor then showed how the feeble light of the fixed stars could be lengthened into an attenuated line, and this line, when minutely examined, was seen to be crossed by dark lines as in the case of the sun, hence we could tell what the stars are made of. Photographs of the spectra of the stars, Aldebaran, Betelgeus, and Sirius were shown, and the metal lines explained. The lecturer then proceeded to notice the nebulæ, remarking that some of them could not be decomposed into groups of stars, but were a sort of cosmical vapour. The spectra of several had been analysed. The photographs of spiral and ring nebulæ were then thrown on the screen, as well as the nebulæ in Andromeda. The distances of these heavenly bodies whose composition could thus be ascertained was immense. The light of the star Sirius, travelling at the rate of 192,000 miles a second, would be twenty-three years in reaching our earth. This was almost nothing to the immense distances of other heavenly bodies. They could not but reflect on the vastness of the Creator's universe, and feel that no common mind had elaborated it all. It made them humble when they contemplated such overwhelming vastness.—*Proceedings of the British Association.*

THE TOTAL ECLIPSE OF THE SUN.

THE New York papers of the 8th and 9th of August are filled with reports of the observations made in various parts of the Continent of the Total Eclipse of the Sun on the 7th of August, 1869. Although in some places disappointment was experienced in consequence of unfavourable weather, yet observations were made elsewhere under more favourable circumstances, sufficient for the more important purposes of scientific investigation. At Washington the observations are reported to have been a failure, owing to causes beyond human control. At Boston, too, great disappointment was experienced; and from Philadelphia only a partial success is reported.

At Springfield, Illinois, the eclipse came off with a cloudless sky and a transparent atmosphere. Extensive preparations had been made for securing accurate observations of the rare phenomenon. An observatory was erected for the occasion at some distance from the town, in order that the instruments might be sheltered and the scientific observers secured from interruption or molestation. The predicted times for this point were: Beginning of eclipse, 4h. 35m. 5–10s. (Springfield mean time); beginning of totality, 5h. 5m. 20 7–10s.; end of totality, 5h. 8m. 10 2–10s.; mean time of eclipse, 6h. 3m. 41 2–10s. The eclipse commenced within a few seconds of the predicted time, at 4h. 45m. The diminution of light was very perceptible, and at five o'clock a singular leaden hue began to spread over the heavens, especially towards the north-west. At three minutes past five, or a little more than two minutes before the total obscuration, the planet Venus was visible with the naked eye.

Within six seconds of the prediction the last rays of the sun disappeared, and that instant the corona burst forth in all its beauty. A moment later the red flash of a protuberance burst forth on the left limb of the sun, like a tongue of flame jutting out horizontally. Soon another jet flashed vertically downward from the lowest limb of the sun. With the aid of the telescope, several more of these protuberances were seen. The heavens became sufficiently dark to permit a view of Mercury, Venus, Mars, Saturn, Regulus, and Arcturus. The horizon all around was lighted up by a sort of dim twilight for four or five degrees in breadth; and above this rim of light hung a dark leaden canopy, increasing in depth towards the zenith. Suddenly the sun burst out again from behind the beautiful corona, and almost instantly the corona and red protuberances vanished. The astronomical observers came to the conclusion that by far the greater part of the phenomenon called the corona, if not the whole of it, belongs to our atmosphere rather than to any atmosphere of the sun or moon. The red projections seem to belong to the sun.

At Mactoon, Illinois, the eclipse commenced at 4h. 10m. 15s. At 5h. 11m. 17s. the sun became totally obscured. The darkness was equal to that of a moonlight night. The eclipse ended at 6h. 9m. 22s. Six spots were visible on the surface of the sun before the eclipse, two of which were very prominent and the others much less. The cusps on the moon had a ragged and blurred appearance. The phenomenon called "Baily's Beads" was distinctly seen by all observers extending through an arc of at least 50 degrees. To the naked eye it seemed as if there were openings in the moon, two on the E. side and one on the SW. The corona was not, as generally described, a halo of light surrounding the moon, but was distinctly seen in the shape of a five-pointed prong on the lower, and two prongs on the upper circumference of the moon, these points presenting a radiant appearance. Although diligent search was made, no planetary bodies were observed between Mercury and the sun. A few minutes after four o'clock the thermometer was at 102 degrees. During the total eclipse it fell to 60 degrees; subsequently it rose again to 80 degrees.

At Des Moines, Iowa, where extensive scientific preparations had been made, the phenomenon was seen under favourable conditions, the weather clearing up towards midday of the day of the eclipse. An unclouded sky allowed the many observers gathered here to witness the eclipse with great distinctness, a slight haze only interfering to prevent satisfactory search for the planets supposed to exist inside the orbit of Mercury. According to Professor J. H. Safford's observations, the first contact occurred at 3h. 43m. 43s. The commencement of the total obscurity was 4h. 45m. 30s. The end of the totality was 4h. 48m. 22s. The last contact was 5h. 45m. 11s. These points of time are from six to twenty-two seconds later than calculated according to Washington—E. P. Himenis and Professor Hillgard

observing it. Another point noted was a discrepancy between the calculation and observation of the corona. It was nearly rhomboidal in form, and very distinct and extended, at some points half a degree beyond the edge of the sun's disc. The rose-coloured protuberances appeared to the number of five or six, the greatest being on the sun's south-western quarter. Professor Harkness's observations of the protuberances in the spectroscope showed different spectra for each; but a single band was thrown by the corona. Professor Eastman's observations of the thermometer showed a fall of 13 degrees in the temperature during the progress of the eclipse. The total obscuration lasted two minutes and fifty-two seconds and a half. Venus and Mercury were distinctly visible with the naked eye. The darkness exceeded that of the night. The most interesting feature in the aspect of the sun was the protuberances or beads. The largest one, already mentioned, was semicircular in shape, with a finger extending, say one eighth part of the sun's diameter, directly downward as one looked. Another right limb was shaped much like the two horns of an antelope. The greatest length of the corona was in the direction of the ecliptic.

At Ottawa. Iowa, the eclipse was observed by Professor Alexander, Chairman of the National Academy of Sciences, who pronounces it to have been the finest of the three total eclipses he has witnessed.

At New York the eclipse was well seen; the darkness was not so great as was expected, nor was there any remarkable change in the barometer or thermometer.

At Cincinnati the gas was lighted, and the atmosphere had a yellowish appearance.

Some gratifying scientific results were obtained at Shelbyville, Kentucky. Professor Winlock observed eleven bright lines in the spectrum, only five having been previously determined. The Professor also observed a shower of meteors between the earth and the moon.

The total Eclipse of the Sun was visible on August 7 in some parts of Siberia and North America. The line of totality crossed the North Pacific, south of Behring Strait, and thence followed a curved course across the American continent to the Atlantic, where the eclipse terminated with sunset off the coast of North Carolina. Two parties of American astronomers took up positions on the Pacific coast, others ascending the Missouri, above Sioux city, but the most thoroughly-organised expeditions were stationed at different points along the line through Iowa, Illinois, and Kentucky. The large 7½-inch equatorial of the Washington Naval Observatory, fitted up for photography, was mounted at Des Moines, where 120 pictures were taken by Dr. Curtiss during the partial obscuration, and two during totality. Size 3½ in. diameter. Equally successful pictures were taken at Springfield by Mr. Black, of Boston, and at Shelbyville by Mr. Whipple, as well as by other parties elsewhere. A small party

sent by the Canadian Government, under Commander Ashe, R.N., of the Quebec Observatory, consisting, besides him, of Mr. Douglas, of Quebec, Mr. Falconer, of England, and Mr. Vail, of Philadelphia, observed the eclipse at Jefferson city, Iowa, and succeeded, in addition to views of the partial eclipse, in taking four pictures during totality. The instrument used was an 8-inch equatorial of 9 ft. focus, made by Mr. Alvan Clarke, of Cambridge, Massachusetts. The day was hazy at Jefferson, and the eclipse did not occur till nearly five o'clock in the afternoon. The actinic powers of the light were therefore weak; and, consequently, the corona did not come out as brilliantly as it otherwise would have done, or as gorgeously as it appears in some of the pictures taken with a very long exposure by other parties. The number of pictures taken, however, enables the passing phases of the eclipse to be the better illustrated. A temporary observatory was used by the party at Jefferson city, which is a thriving little town of 800 people and three years' growth. The party were throughout treated with the greatest courtesy.

ON COMETS. BY PROFESSOR P. G. TAIT.

The principal object of this paper was to investigate how far the singular phenomena exhibited by the tails of Comets and by the envelopes of their *nuclei*, the shrinking of their *nuclei* as they approach the sun, and *vice versâ*, as well as the diminution of period presented by some of them, can be explained on the probable supposition that a comet is a mere cloud of small masses, such as stones and fragments of meteoric iron, shining by reflected light alone, except where these masses impinge on one another, or on other matter circulating round the sun, and thus produce luminous gases along with considerable modifications of their relative motion. Thus the gaseous spectrum of the *nucleus* is assigned to the same impacts which throw out from the ranks those masses which form the tail. Some of the most wonderful of the singular phenomena presented by comets, such as the almost sudden development of tails of many millions of miles in length, the occurrence of comets with many tails, and the observed fact that there is no definite relation of direction between a comet's tail and its solar radius-vector, were here looked upon as due to the differences of motion of these discrete fragments relatively to the earth in a manner somewhat analogous to the appearances presented by a distant flock of seabirds flying in nearly one plane, and only becoming visible as a long streak when the plane of the flock passes approximately through the spectator's eye. The so-called envelopes are compared with the curious phenomena presented by tobacco-smoke (which seem, however, to be emitted in a form apparently resembling thin continuous films of small particles of carbon), and the so-called "gaseous jets" which appear to be projected from the *nucleus* and to be repelled from the sun, are not difficult of explanation,

the author considered, from the general points of view here taken. Investigations, mainly conducted by quaternions, show how a group of discrete masses, so small that their mutual perturbations are not of great moment except in the case of actual impact, gradually changes its form, as it revolves about the sun, independently of any hypothesis as to the cause, planetary attraction or otherwise, by which it was first introduced into the solar system. The ideas here brought forward occurred to the author more than two years ago, on his being made aware of the identity of the orbits of the August meteorites and of Comet II., 1862; but they seemed so obviously to follow from that identity, that it was only on reading Dr. Tyndall's recent speculations, and on being informed by Professor Newton that the questions of tails, envelopes, and "gaseous jets" had been treated by Schiaparelli as proving the existence of a repulsive force, that he ventured to produce an explanation so apparently simple and yet so inconsistent with what appears to be held by the majority of astronomers.

The new theory of the origin of the tails of comets, above referred to, has been propounded by Professor Tyndall in his lecture to the Cambridge Philosophical Society. The tails of comets are, he says, turned from the sun, and their growth is too rapid to be consistent with the hypothesis that they have been projected from the comet, or have been left behind like the fire of a rocket in its course. Professor Tyndall believes that they are produced by actinic action, in much the same way as the symmetrical clouds are produced by certain vapours in tubes by the action of light. The heat, he considers, disperses the cloud, and the light produces it; and, as the heat is intercepted by the body of the comet, a tail is produced by the deposit of vapours in the tract where this interception takes place. By this theory there may be invisible comets as well as visible, and many inscrutable phenomena may result from the mingling of invisible cometic emanations with our atmosphere.

RELATIONS BETWEEN METEORS AND COMETS.

An interesting scientific fact is becoming the subject of attention, as to the Relation between Meteors and Comets. Dr. Bedford (a gentleman well known in the scientific world) published, in 1854, a pamphlet entitled *New Theories of the Universe*, in which he stated that there was a relation between meteors and comets, and that both move in orbits. This discovery was made by a careful comparison of the records of these bodies from the earliest times. Also, in refutation of the then existing theory as to the physical constitution of the solar orb, he affirmed advanced views as to its igneous nature, which were at the time, like the theory of Galileo, scouted by the other philosophers of the day. Recent experiments, however, says the *Wiltshire County Mirror*, have not only proved the truth of Dr. Bedford's

theories, but they have been acknowledged, for two successive years (1867-68), by Professor Pepper, in his Lenten Lectures on Astronomy, at the Royal Polytechnic Institution, London, as forming the groundwork "of the grandest system of astronomical science," and "well worthy of being studied." The subject is now looked upon as highly important in a scientific point of view, and is likely to lead to a complete revolution in the science of astronomy.—*Mechanics' Magazine.*

THE NOVEMBER METEORS.

In a communication from Egypt, to the *Times*, the night of the 13-14th of November in this part of the world is stated to have been not very favourable for the observations of the shower. Half a gale of wind was blowing from the northward, and heavy clouds continually passing, rarely left a third of the sky visible. Nevertheless, tolerably good observations were made.

As early as the 8th of November, small Meteors were noticed radiating from the constellation Leo, and on the morning of the 10th, between 1 and 4 o'clock, they were observed to radiate from that constellation at the rate of eight per hour. On the morning of the 11th, about the same time, the rate was six per hour from Leo; but on the 12th there was no sign of radiation from that quarter, although from other parts of the heavens shooting stars were seen to the number of sixteen per hour for three hours.

On the morning of the 13th, out of thirteen registered meteors, four radiated from Leo, one of which, at 2h. 50m., Alexandria mean time, passed exactly over the stars μ and α Ursæ Majoris. Its great brilliancy and bright streak, combined with its direction and apparent velocity, left little doubt that it belonged to the November system.

The morning of the 14th, as mentioned before, was very unfavourable. Above the lower cloud stratum was a haze which obscured the smaller stars. Notwithstanding, a brilliant display was seen of short duration, corresponding in this latter particular more with the shower of 1867 than any other recent showers. From half-past 12 to 1.15 a.m., a large portion of the sky being clear overhead at times, only two small meteors were seen, neither of which radiated from Leo. At half-past 2 the watch was resumed, and between large openings in the clouds the shower was seen at its height. Most brilliant meteors, many of which illuminated the view around like flashes of lightning, often of a bright green colour, shot with astonishing rapidity at the rate of one or two every minute. This continued, at about the rate, until 4 o'clock, when there was a sudden diminution in the numbers, and before 5 o'clock all was over.

The tendency to appear in flights, which the November stream always exhibits, was noticed on this occasion; a few appearing in rapid succession, and then a considerable lull.

The following table shows the actual numbers observed and the elevation of the radiant point. The whole of them being bright meteors, it is very probable that had the sky been perfectly clear, at least twice as many would have been seen:—

NOVEMBER 14, ALEXANDRIA MEAN TIME.

From H.M.S	To H.M.S.	No. of Meteors	Elevation of the Radiant Deg.	From H.M.S.	To H.M.S.	No. of Meteors	Elevation of the Radiant. Deg.
2 30 0	1 15 0	0	15	3 59 0	4 7 4	16	54
2 30 0	2 40 0	16	35	4 12 0	4 24 0	16	57
2 52 0	3 2 5	16	40	4 26 0	4 38 0	6*	60
3 8 0	3 19 7	16	43	4 40 0	4 52 0	7	68
3 24 0	3 33 6	16	46	4 54 0	5 14 0	4	67
3 38/5	3 52 5	16	50				

Only seven other meteors were seen, they are not included in the table, because they radiated from other quarters of the heavens. If these numbers be corrected for the elevation of the radiant, it will be seen that the meteors were falling in the greatest numbers at the time the shower was first seen. Hence it must have commenced and attained its *maximum* between 1 o'clock and 2.30. The lengths of the paths varied with their distance from the radiant, from a few degrees to 15 or 20 degrees. The time of flight seemed less than half a second—too short an interval to estimate accurately. Three meteors only deserve special notice.

The first occurred at 3h. 32m. near θ Hydræ. It was exceedingly brilliant, and shot almost instantaneously through an arc of 10 or 12 deg. and then exploded with a blaze of light which illuminated everything around. Some of those on deck remarked that it was lightning. At the spot where the explosion occurred there remained a small luminous cloud about a degree and a half in diameter, like a nearly closed horseshoe in form, the internal darkness being about one-third the external diameter. This "cloud" did not sensibly change its position or intensity during the two or three minutes that attention was paid to it. It was in R.A., 140 deg.; decl., 4 deg. N.

The second occurred at 3h. 40m. in Ursa Major. It was, if anything, brighter than the preceding, and illuminated the heavens with an intense green light, leaving an exceedingly brilliant white streak about 8 deg. in length, the centre of which was in R.A., 131 deg.; decl., 55 N. In about a minute this streak assumed a wave-like form, very regular from end to end, still continuing very bright. It then slowly took the form of a large, irregular letter S, some 6 deg. in length, and drifted over the star *o* Urs. Five minutes after its first appearance it was concealed by clouds, being then pretty bright.

The third was also remarkably bright, of a greenish hue, and exploded like the first. The position could not afterwards be identified. These were the only two that regularly exploded.

* It was very much more cloudy during this observation than previously, and much clearer afterwards.

From a number of paths that were observed, most favourably, in the immediate neighbourhood of the radiant, the position of that point was determined to be in R.A., 151 deg. ; decl., 21 5 N. But it was remarked that no single point could possibly satisfy all the observed paths, which proves that the orbits of the individual meteors are not perfectly similar to one another.

As the denser part of the stream only lasted four hours it was not more than 72,000 miles in thickness, measured perpendicularly to the plane of its orbit; but this may have been one only of a number of similar aggregations, making up altogether a more extensive stream.

On the morning of the 15th, from 3.30 to 3.30, the sky being about one-third clear, only five meteors were seen, and they radiated from the constellation of Orion.

It may be noticed that these observations confirm in an absolute manner the existing theories of the motions of these bodies.

G. L. Tupman.

Her Majesty's ship *Prince Consort*,
off Port Said. Egypt, Nov. 15.

LUMINOUS METEORS.

The Report of the Committee of the British Association, by Mr. J. Glaisher, contains the results of assiduous observations of shooting stars, directed principally to the periodical dates when shower meteors were usually expected to recur, besides the recorded description of many Large Meteors, which have appeared with more than ordinary frequency since the last Report, and the fall of Aerolites. Of large meteors the most remarkable were those of September 5, 1868; October 7, 1868; and May 31, 1869. The course of the large meteor seen in Central France on the evening of the 5th of September, 1868, was little less than 100 miles in length, over the valleys of the Seine, the Yonne and the Loire, north and west of the mountains of Côte d'Or and Auvergne—directed, apparently at no great inclination to the horizon, from north-west to south-west, at a height of upwards of fifty miles above the earth. The very distant observations of the same meteor at Aosta and Florence, however, seems to indicate, for the earlier portion of this meteor's flight, a far more extraordinary length of course than is common among large fire-balls. From the facts noted may be obtained the minima of velocity with respect to the earth and sun, and which are, namely, respectively 80 and 71 kilomètres per second. Now, were the orbit described by this meteor elliptical, or even parabolic, the velocity could not exceed 42 kilomètres: there can, therefore be no doubt that the trajectory was an hyperbola. This, it is believed, is the first time that the path of the fire-ball has been ascertained from trustworthy mathematical data. From this starting-point M. Tissot finds that the meteors passed over that place

at a distance of 3 deg. 12 min. from the zenith. The meteor merely passed through our solar system; twenty days after it made its appearance it passed through its perihelion, the distance of which from the sun is about the same as that of Mercury. The bolis is now further away than Saturn, but has not yet got beyond Uranus.

The principal remarkable feature of the fire-ball of the 7th of October, 1868, was its vast volume—much larger than that of any other meteor seen for many years. Two other circumstances appeared also to be of some important interest, viz.: 1. The immense distance to which the series of detonations was heard —over an area of more than 190 miles in width, incomparably surpassing the distance to which the longest claps of thunder or the discharges of the largest cannons can be heard. If, moreover, the statements of the majority of the observers may be trusted, the interval between the bursting of the meteor and the sound of the report was so great that the phenomenon must have taken place at a prodigious height. Less than five minutes cannot be allowed, on the most moderate estimation, from the explosion of the meteor to the first sound of the report, and this would imply a distance of more than 60 miles. Taking into account the direction of the meteor as seen by the observers, it would be difficult to admit a height of less than 48 miles. This height is confidently within the limits which it would be necessary to assign to it, when the greater number of exact descriptions of the meteor, given by competent observers, are taken into the account. Other large meteors were described. The meteors of the 14th of November, 1868, were well observed. They were widely separated from a large number of meteors observed in the United States of America on the morning of the 14th of November last. Professor Newton has selected several instances of meteors of conspicuous brightness, which were simultaneously observed by observers at distant places. The results were accompanied by two excellently executed plates of the persistent streaks, some of which presented peculiar features, as given in the *American Journal of Science* for May, 1869 (vol. xlvii., p. 399), and lead to the supposition, from the observed motions of translation and distortion of some of the streaks, that a northward current of the upper air prevailed below an altitude of about 54 miles, and that above this level, to a height of about 60 miles, a current of air existed, moving in a northerly direction. The double appearance of the streaks observed with the telescope, in some of the meteors of the shower, suggests the probable conjecture by Professor Newton of an actual duality in the meteor itself; and a very possible analogy, it is thought, may thus be recognized among the November shooting-stars, to the double or multiple character which is common among the detonating and stone-producing meteors.

AURORÆ BOREALES AND MAGNETIC PERTURBATIONS.

Mr. H. Wilde has sent to the Academy of Sciences of St. Petersburg a note on the Auroræ Boreales of April 15 and 16 and May 13 and 14, 1869, and on the relations which exist between these phenomena and Magnetic Perturbations. On April 14 a very severe magnetic storm was recognised by the people in charge of the electric telegraphs; but the cloudy condition of the sky prevented the auroræ being seen, and thus the cause recognised. All the directors of the Russian observatories reported simultaneous magnetic disturbances of a similar order. Mr. Wilde remarked also that similar perturbations were recorded in France, England, Italy, and all over Europe. The auroræ of May 13 furnished another example of the same kind. On this occasion M. Rudneff called Mr. Wilde to show him the extraordinary oscillations of the magnetic needles. In spite of an attentive observation of the northern sky, no trace of auroræ was seen, probably owing to the cloudy state of the sky. But the author remarked there was now no doubt that on that evening a very splendid aurora was seen at Moscow and other observatories better placed for the purpose. Mr. Wilde then gave long quotations from the reports of MM. Struve, Wagner, Gylden, and others.

GREAT METEOR.

His Grace the Duke of Argyll writes from Kensington:

"On last Friday night (July 16, 1869,) I happened to be looking at the sky at the moment of the appearance of the Great Meteor which is described by Mr. Herschel in the *Times* of yesterday. As the night was clear, I had an unusually perfect view of the whole course of the meteor.

"It began in a thin streak of red sparks, very like a common rocket, but as it advanced, which it did with immense velocity, the light became more and more brilliant, until it rose to that of an intense 'white heat.' It gave off jets or sputterings of light along the whole of its course, and from both sides of its body. These were particularly remarkable when the meteor was at its *maximum* of splendour. Its disappearance was extremely sudden, as if its substance were wholly consumed. For a second there was left a train of sparks. I could hear no sound.

"It began not far from the zenith, and the direction of its path was from NNW. to SSE., but the whole course was very short.

"Argyll."

"The brilliant Meteor of Friday night (July 16) which Professor A. S. Herschel described in your columns as having been but imperfectly seen by him at Hawkhurst, on account of the cloudy state of the atmosphere, was visible to us in the north of London under the most favourable circumstances for observation.

"I noted the time of its appearance, which exactly coincides

with that already given you by Mr. Herschel (11h. 35m. P.M.), and observed that its path was not continuously illuminated, but appeared broken, for quite half the length of its flight, into a train of brilliant sparks. Its termination was marked by an explosion and a display of incandescence which lighted up the objects around us as in full moonshine. The smaller meteoric bodies into which the principal mass became divided were very quickly extinguished, and I looked in vain for the luminous track in the heavens which sometimes lingers after these brighter kinds of meteoric displays. The atmosphere was at the time unusually clear and calm, and the light appeared to me to be perfectly white. There was no audible sound accompanying its final extinction. "JOHN SPILLER,

"*Hon. Secretary of the Photographic Society.*"

A CORRESPONDENT writes of this Meteor seen in Birmingham:—"It was but a momentary glance, but sufficient to show that the meteor was one of no ordinary magnitude. It disappeared in the SE., at an altitude of somewhere about 35 degrees, as nearly as I could estimate it. The meteor appeared considerably larger than the planet Venus when at her greatest brilliancy, and the colour was decidedly blue. No sound accompanied the meteor that I could discover, but the heavens were illuminated as by a flash of lightning."

BRILLIANT METEOR.

MR. JAMES RICKETT writes to the *Times* from Cotterstock Oundle, Northamptonshire, Dec. 13:—"I was walking last evening within a quarter of a mile from this village, with my face eastward, when at 6h. 13m. 30s. P.M., Greenwich mean time, I was startled by the bursting forth of a splendid Meteor, nearly due east, and about four or five degrees above the horizon. It took a westerly course, and made a gentle curve or arc under the plane of the constellation Ursa Major. Its greatest altitude attained was from 18 to 20 degrees. Its motion was not rapid, as I think it must have been in sight from 15 to 20 seconds. On passing to the westward of the Ursa Major group, it broke up like a rocket, at about the same altitude in the western quarter as that at which it made its appearance in the eastern. It was far the most brilliant meteor I have ever had the good fortune to behold, in size as large as the planet Venus, but of an intensely bright bluish light. It was surrounded by a beautiful halo, so that I could distinctly see nearly all the prismatic colours. When it exploded, which it did, as I have described, like a rocket, it fell in a bouquet of stars as bright as the parent meteor, and beneath each of them were pendants of a dull red colour, like the falling of some burnt-up substance. The evening was beautiful and still, the atmosphere overhead very clear; the moon shone brightly, so that I had no difficulty in seeing my watch. Jupiter and Venus were in all their glory. There was

a thick mist near the horizon, amounting almost to a fog; this, with the low altitude, will account for the beautiful halo. I heard no sound on the explosion, but then my hearing is imperfect. I have spent the great part of many hundred nights on a ship's deck at sea, but never in any latitude have I seen anything so grand as this splendid meteor."

METEORITES.

If these substances possess no interest from a utilitarian point of view, there are few things which possess more when regarded from any other. Assuming the reader to be acquainted with the constitution of Meteorites, and the condition in which iron is found in them—that is to say, in a pure state, instead of in the form of iron ore as dug from the mine—we may now state that, according to M. Stanislas Meunier, a great step has been made towards a positive knowledge of the source from whence they issue. Various hypotheses have been put forward at different times on this subject: some have suggested that they were formed by a combination of atoms of iron, nickel, and the other substances found in meteoric iron, which they supposed to be floating in the atmosphere; others have conjectured that they were thrown out of volcanoes in the moon, and some have maintained the hypothesis that they were erupted from the earth itself. Without entering upon a discussion of either of these theories, it may be stated that M. Meunier says that on examining the mass of meteoric iron found at Deesa, in Chilli, he found it to possess an unexpected resemblance with a block found at Caille (Maritime Alps) and another which fell at Setif, in Algeria, on the 9th of June, 1867. The Deesa meteoric is a compound of these two stones; it contains an iron identical with that contained in the Caille meteorite, injected in a state of igneous fusion into a stone identical in substance with that of Setif. The Deesa stone is, therefore, an erupted block, and is the first of the kind that has been discovered. Moreover, it is clearly shown that the iron of the Caille meteorite and the stone of that of Setif have a similar stratification, consequently they are supposed to have formed part of the same unknown globe, and this is the first time such a connection has been materially demonstrated. He observes that the meteorites which now fall on the earth are not of the same mineralogical nature as those which formerly fell on this globe. Originally they were masses of iron (a very large block may be seen in the British Museum, which was found on the plateau of Quito), but only three such masses are known to have fallen within the last 118 years, whereas there have been on an average three falls of meteoric stones yearly. The greater part of the numerous pieces of iron deposited in collections have fallen at unknown epochs; the meteoric stones are of comparatively recent date. Perhaps it might with more correctness be said that the meteoric stones

which fall now are of a new kind, for none of a carboniferous nature are known to have reached the earth previous to 1803, whereas there are four known instances since that time. From these combined facts he concludes that the meteorites are the ruins of one or several celestial bodies of geologically recent date which moved round the earth, or possibly round the moon, which, having gradually lost their internal heat—long before the moon, owing to their lesser volumes—have, in the coldness of space, crumbled apart gradually, portions being left in various parts of the orbit in which they formerly moved, thereby forming a kind of ring of fragments, or rather a series of rings, according to the densities of the different masses; that the masses nearest the centre of the disintegrated planet, containing the largest proportion of iron, came first within the range of the attraction of the earth, and that these have been followed by meteorites composed partly of metals and partly of stone, such as now occasionally reach us. He anticipates that these may hereafter be followed by stones containing less and less metal. The conclusions he arrives at are that the fate of this planet exhibits what will eventually be the doom of the moon, the globe we inhabit, and all the other planetary bodies of the system, of which the sun alone retains the original type.—*Times.*

THE AUSTRALIAN SKIES.

More than a year ago a discovery was announced by an astronomer in the Southern hemisphere, which seemed so strange and so perplexing, that Sir John Herschel, commenting on it, remarked "that no phenomenon in astronomy had yet turned up presenting anything like the same interest, or calculated to raise so many and such momentous points for inquiry and speculation." One of those mysterious nebulous masses which astronomers had been in the habit of regarding as galaxies, resembling in extent and magnificence the sidereal scheme to which the sun belongs, seemed to be undergoing an astounding series of changes. During these winter nights, when Orion shines with full glory, the famous nebula which clings around his pendant sword presents to our northern observers an object similar to the nebula in question. Every one has heard of the strange interest which attaches to this Orion nebula, of the mysterious far-reaching arms which extend from it, the dark central vacancy, and the brilliant array of stars which the six-feet mirror of Lord Ross has brought into view in the very heart of the nebula. But in the Southern skies there is an object of the same class even more glorious and more mysterious. In the richest part of the southern heavens, a part so rich indeed that, according to the argument of a well-known astronomer, the splendour of the constellations comprised in it illumines the heavens as a new moon would, there lies the great nebula known among astronomers as "the Nebula in Argo." The Orion nebula can only be seen on the darkest nights, but the great Argo nebula shines as brilliantly

as a third-magnitude star, and is scarcely obliterated even by the effulgence of the full moon. It is, in fact, the most splendid nebula in the whole heavens. Yet this glorious object, whose contemplation has led our most thoughtful astronomers to form new ideas of the grandeur of the universe, whose dimensions seemed immeasurable by any unit of length men could devise, the whole of this magnificent nebula is drifting about like a cloud before a shifting wind.—*Spectator.*

ANTARCTIC DISCOVERY AND THE TRANSIT OF VENUS.

There has been read to the Royal Institution a paper by Staff-Commander Davis, who had sailed in the *Terror* in Sir James Ross's Expedition towards the South Pole, "On Antarctic Discovery and its Connection with the Transit of Venus in 1882."

Commander Davis in his paper gave a brief historical sketch of the progress of Antarctic discovery from the voyage of Dirk Gerritz, a Dutchman, who sailed in the *Good News*, from Rotterdam, in 1599, and discovered the islands of South Shetland; to the expedition of the *Erebus* and *Terror*, which left England in September, 1839, and made two successful pushes towards the south, the first at the end of 1840, and the second at the end of 1841. All the various discoveries of land within or near the Antarctic zone were passed in review, and the accounts of the different navigators analysed, reasons being given for finally erasing some portions of land from our maps which were said to have been seen, but had been, in the experience of the author of the paper, satisfactorily proved to have no existence. Cook attained the high latitude of 71 deg. 15 min. in January, 1774, and Bellingshausen, the Russian navigator, reached 70 deg. in the same month of 1821; but to Weddell, in 1823, the honour was due of advancing the nearest to the South Pole, before the voyage of Sir James Ross, this gallant officer having reached in two small sailing vessels 74 deg. 15 min. of south latitude, being 185 miles further south than any navigator that had preceded him. Ross, in 1841, reached 78 deg. 4 min. south latitude. Some years afterwards (1830 to 1839) South Polar exploration was much encouraged by the spirited and enterprising merchant, Mr. Enderby, one of whose vessels, under Biscoe, discovered Enderby Land (on the meridian of Madagascar) and Graham's Land, due south of Terra del Fuego. In this voyage Biscoe passed over 160 degrees of longitude, south of the parallel of 60 deg. After a sketch of the discoveries of Lieutenant Wilkes, D'Urville, and Sir James Ross, the author proceeded to explain the phenomenon of the transit of Venus over the sun's disc, which occurred only twice in a century, and the accurate observations of which would enable astronomers to ascertain the precise distance of the earth from the sun, calculations of this distance having varied lately to the extent of between four and

five millions of miles. By observing the time of ingress and egress of the planet on the sun's disc (the passage occupying six hours) at two stations, separated from each other by as nearly as practicable the whole diameter of the earth, the distance could be arrived at. The transit would occur on the 6th of December, 1882, and one of the two stations must be in a high southern latitude. Crozet's Island and Kergueland Land would not be desirable, on account of the constantly clouded skies of those places. Sabrina Land, one of the points suggested by the Astronomer Royal, would most probably offer a range of mountainous land between the observers and the sun, and was not, therefore, to be recommended. The author gave the preference to Possession Island, near the coast of South Victoria, on which Ross's Expedition landed in 1841, provided no harbour be found on the mainland of South Victoria or on Coulman Island (lat. 73 deg. 45 min.). As the transit occurs so early in the southern summer as the 6th of December, it would not be possible to reach so high a latitude and erect the observatory in the same season; the party would, therefore, have to be landed the previous summer and winter there, the ships proceeding to Hobarton to refit, and returning to fetch them when the observations were completed. In conclusion, the author expressed his ardent hope that England, who had already gained the chief honours in Polar discovery, would take the leading part in carrying out this magnificent enterprise.

Captain Richards, R.N. (Hydrographer to the Admiralty), said that he had no doubt the Government would be prepared to carry out the suggestions of the Astronomer Royal when the time arrived. It was necessary, however, to bear in mind that circumstances had changed since the *Erebus* and *Terror* were despatched on their famous voyage to the South Magnetic Pole. The Admiralty could then order such expeditions, but they no longer had that power; it was to the public opinion of the country now that the initiative belonged; but he had no doubt that, as the country took so great an interest in the transit of Venus in 1786, it would not fail in desiring an expedition in 1882, and it rested with such bodies as the Royal Geographical and other societies to arouse public interest in the matter.

In the discussion which followed, Captain Sherard Osborn expressed the opinion that to insure the success of an Antarctic Expedition in 1881 it was necessary to train men beforehand for the arduous navigation of those icy regions, and this could best be done by Arctic exploration. The present time of peace was favourable to the employment of our ships and men in such expeditions, in which science would be benefited and experience gained.

Admiral Collinson, Sir L. M'Clintock, Dr. Rae, and Admiral E. Ommanney spoke to the same effect. Sir E. Belcher and General Lefroy also took part in the discussion.

THE TRANSIT OF VENUS.

England is to be represented in the expedition to be sent out to various parts of the world, to observe the approaching Transit of Venus, upon which the following very able paper has appeared in the *Saturday Review*, August 14, 1869:—"The problem which has to be solved, which the Astronomer-Royal has well called 'the noblest problem in astronomy,' is the sun's distance from the earth, and it may be well to show at the outset why and how it is thus attacked. It is well known that, to find the distance of any object on the earth from us, it is not at all necessary to walk over and actually measure mechanically the interval; it suffices to mark out a much smaller distance, called a base line, and then from either end of this base line, to observe the angle between the distant object and the other end of the base. Only one condition is necessary; and, for instrumental reasons, the base line must be of appreciable length with regard to the distance of the object. Such a mode of measurement even may be applied to the moon, which is roughly a quarter of a million miles off, the observations being made, say, at Greenwich and the Cape of Good Hope, since the distance between those places—the base line—is appreciable when compared with the moon's distance. But when we come to the sun the case is different. If we could place two observers on the Equator, one in longitude 0 deg., and the other in longitude 180 deg., we should then have the largest diameter of the planet as the base line; but, compared with the sun's distance, 7,900 miles (the earth's largest diameter, and consequently the greatest distance between any two places on it) is instrumentally *nil*—our base line is inappreciable—and this, the most obvious and direct method, therefore fails.

"It is generally supposed that Halley was the astronomer who first pointed out the flank attack on the sun's distance rendered possible by the transits of Venus over the sun's disc; but this is not the case. The suggestion is due to James Gregory, who suggested in 1663 that observations of Venus or Mercury, when they come between us and the sun, and are seen to pass over his disc, may give us the required information. An attempt to explain this will require a little attention. The method is really founded on one of Kepler's laws, by which mankind became acquainted with the *relative* distances of the planets from the sun long before they could determine their *absolute* distances. The thing to be done, therefore, is to measure the distance of the nearest planet from us, and then something like a rule of three sum tells us the distance sought, *i.e.*, the sun's distance from us. Now the planet which in its journey round the sun comes nearest to us is Venus, and she comes, as we now know, near enough to allow us to apply the base line method, as in the case of the moon, were it not for the unfortunate circumstance that, as her path lies within ours, when she is nearest to us she is

between us and the sun, and consequently has her non-illuminated side turned towards us, so that she is generally invisible at such times. But not always, for sometimes she comes exactly between us and the sun, and appears as a black dot on the sun's face; that is, we have a transit of Venus over the sun.

"Now let us see what happens, and let us regard the sun as a screen on which the planet is visible. In the first place, an observer at the centre of the earth would see the planet travelling in a straight line over some part of the disc. An observer at the North Pole would see the planet's path projected lower down on the sun; similarly an observer at the South Pole would see the path projected higher up. In fact, as seen from the North and South Poles, the paths of the planet over the sun would be separated by a certain interval.

"Now suppose the sun to be exactly as far from Venus on one side as the earth is on the other, it is evident that the apparent interval between the two paths would represent on the sun a distance exactly equal to that between the two observers; but we know, to start with, that the distances of Venus from the earth and sun are as 28 to 72 nearly, so that the interval between the two paths will always bear this relation to the distance between the two stations on the earth from which they are observed. If it were possible at the same moment of time to photograph the planet on the sun from two distant stations such as we have imagined, the problem would be at once solved, and in this way. We could determine the length of the line, as seen at Venus, which joins the two stations on the earth at which the observations are made; we could then increase this in the ratio of 28 to 72, to find the exact separation of the black dots representing Venus on the photographs. Hence we could determine the size of the sun, and hence its distance. But in practice the thing is not so easy, the amount of separation of the apparent paths of the planet over our screen—the sun—can only be laboriously determined from their length, because simultaneous observations are out of the question; and as the difference in the lengths of the paths—that is, the time the planet takes to travel over the sun—is thus the point of inquiry, it is necessary to make this difference as great as possible to give accuracy to the result. From this requirement comes the necessity of choosing the stations at which the transit is to be observed, most carefully bearing in mind at the onset that the earth is a rotating globe—a consideration which complicates the matter to a tremendous extent. Hence it was that Captain Cook went to Otaheite in 1769 on the occasion of the last transit, that Father Hell observed in Lapland, that Mr. Green observed at King George's Island in the South seas, and so on.

"Before we refer more particularly to the next transit, it will be well to give the results of the last, and to state briefly the work that has been done in the interval, in order to give an idea of the extraordinary interest which centres in the observations of

the one in 1874, for observations of which the arrangements will require to be begun at once. If we take up an early edition of Ferguson's *Astronomy*, an admirable book written about the middle of the last century, we shall find it roundly stated that the earth's distance from the sun is 82,000,000 miles. The first transit of Venus, in 1763, brought this up to 95,173,000 miles, a number so near the one obtained in the next transit, that of 1769, that till quite recently some foul play was suspected in the observations made in the last-named year to render the results similar. Fortunately, however, we are now no longer dependent upon transits of Venus. Our instrumental means are now so greatly improved that we can apply the base line method to Mars, and not to mention other means, even the velocity of light has been brought to bear on the problem; and, singularly enough, the result of all this modern work and of more indirect methods has been to show that the value of the distance derived from the observation of the transits in the last century requires to be reduced by something like 4,000,000 miles. It might be imagined from this high number that the astronomers were egregiously at fault, but the delicacy of the problem must be borne in mind. The error they made in the sun's angular diameter, granting it to be an error, is no greater than the breadth of a human hair viewed at a distance of 125 feet.

"But this is not all. Soon after the concordant results of all this work had so satisfied astronomers of the necessity of reducing the received value, Mr. Stone, of the Greenwich Observatory, carefully and wisely going over the old work in order to be able to direct the proposed observations, found that an excessively curious phenomenon, to which we can only refer, observed at the transits, had misled the observers, and that, if its influence were taken into account, the value of the sun's distance obtained from the transit of 1769 was marvellously concordant with the recently determined value. Mr. Stone has received the gold medal of the Royal Astronomical Society for this research, and well he deserves it. The conclusion at which he has arrived will enable the observers of the approaching transit to obtain results of the last degree of accuracy.

"To make the most of the transit of 1874 it will be desirable to have observations made at Owhyhee, Marquesas Islands, Kerguelen's Island, Crozet Islands, Mauritius, Rodriguez, some station on the Southern Continent, Auckland Islands, New Zealand, and Alexandria, and some other stations which need not be included in this list. In connection with these places there are two reasons why the arrangement must be made at once. It is absolutely necessary that the longitudes of Woahoo (Owhyhee), Kerguelen's Island, Mauritius, Auckland, and Alexandria should be determined with the greatest accuracy, not merely with the transit of 1874 in view, but to help in the transit of 1882. Hence we shall want five sets of instruments, consisting of a transit, altazimuth instrument, a clock, several telescopes, and several chronometers, and

at present these instruments do not exist. Secondly, it may be well to determine the longitudes before the transit, and not while it is going on. The desirableness of this course seems indeed obvious. But, after all, the most important consideration is that connected with the observations on the Southern Continent. Although observations here will be essential in 1882, the Astronomer-Royal, we gather, does not insist upon them for the transit of 1874, although their desirableness is beyond all question.

"Admiral Ommanney, no mean authority on such matters, is for a preliminary survey of the coast of the Antarctic Continent before the transit of 1874—Victoria Sound being explored with the greatest care; and he points out that up to the present time we have not availed ourselves of steam-power in the higher southern latitudes; and Staff-Commander Davis, the companion of Sir James Ross, strengthens this view, as he maintains that it will be essential that the observing party should pass the winter in huts on the continent itself, as the ships could not winter there. If this should turn out to be the case, let us hope that the comfortable time and 'plenty of penguins to live on,' which Commander Davis promises, will be realised. It might easily happen that the observation of the transit would be only one among many scientific advantages resulting from such a sojourn."

METEOROLOGY OF INDIA.

As our readers are aware, a regular system of Meteorological Observations for Great Britain and Ireland, under competent direction, has been for some time in operation, and with encouraging results. Meteorological Observations are made in India also, but we have not heard that they are conducted on a uniform system, or that any care has been used to refer the instruments employed to one trustworthy standard. And yet the Meteorology of India should be a subject of the highest interest and importance. When we consider the vast extent of country, its different elevations, from the Himalayas with their perpetual snows to the torrid heat of the sandy plains and the sweltering temperature along the coasts, the periodical winds and rains, we see that phenomena of the weather are there to be studied on the grandest scale. That the study would prove highly instructive and advantageous to science cannot be doubted. It is true that Colonel Strange, as inspector of scientific instruments to the Government of India, is doing good work at the depôt in Belvedere Road, Lambeth; but until all the instruments he sends out are accompanied by uniform systematic instructions for use, and all are comparable by one standard, we shall not obtain such a knowledge as we require of the meteorology of India. Meanwhile there is useful information to be gathered from the annual reports of weather in different districts, as we recently pointed out; and now we have Mr. Neil's Report on Meteorological Observations registered in the

Punjab during 1867. It presents particulars of atmospheric pressure—temperature (in shade and sun), humidity, direction of wind, and rainfall. Mr. Neil explains that he gives the rainfall from thirty-two stations throughout the province, with a view to show the connection between the fall of rain, whether general or local, and the contemporaneous atmospheric pressure, and direction of wind. The particulars are given for every month of the year; and in addition there is an account of Ladakh and its climate, which should be interesting to meteorologists and geographers. It is the most westerly country inhabited by the Thibetan race, with a length of 200 miles and a mean breadth of 150 miles. The summer climate is described as delightful; the malarious forms of fever are almost if not quite unknown; bronchitis and lung diseases generally are very rare, and the same may be said of diarrhœa and dysentery. And when we add that a summary of daily observations for one year on the climate of the Pangi Valley, made by the officer who superintends the felling of timber in Pangi, is included in the Report, weather students may, perhaps, judge the better of its value as a work of reference.—*Athenæum.*

NIGHT TEMPERATURE.

Dr. Stark reports that one of the most important elements bearing on vital statistics is Night Temperature. It is the night temperature, far more than that of the day, which has the most deleterious influence on human life. He recommends that, along with the statistics of mortality, both the absolute and the mean lowest or night temperatures should be published. Experience in Scotland has shown that an excessively cold night, when the temperature falls to ten degrees or to five degrees, or below zero, the change is most fatal to the aged, to the very young, and to those weakened by disease. In some of the smaller parishes of Scotland a cold night has been known to kill all persons above 80 years of age; husband and wife, brother and sister, being found dead in their beds in the morning after such a night of cold.

THE HOURLY SELF-RECORDING ANEROID BAROMETER.

This new instrument was introduced to the Meeting of the British Association at Exeter, and is constructed by the London Stereoscopic Company, Cheapside and Regent Street.

Those who have been in the habit of watching the Barometer from day to day, and of recording its indications at stated hours, know that between the intervals of making the record, important fluctuations in the index take place, which, if recorded, would furnish valuable data as to the *general tendency* of the atmospheric pressure. The Hourly Self-Recording Aneroid Barometer is designed to supply this information.

It consists, in the first place, of a large and powerful Aneroid

An eight-day clock, with 8-inch dial of special construction, having a pendulum ten inches in length, beating half-seconds, furnishes the means of making an hourly record.

Between the clock and the barometer revolves a vertical cylinder four inches in diameter, having a paper attached to it, ruled to correspond with the barometer scale, and near to this paper is fixed the guide-rod supporting the pencil, which, by simple mechanism connected with the clock, marks its own position at every hour.

The paper, besides being ruled horizontally into inches and tenths, to correspond with the barometer scale, is divided vertically into seven principal and seven minor divisions, indicated by darker and lighter lines. The light lines represent the noon, and the darker lines the midnight, of each twenty-four hours; the paper thus lasts one week.

By these means a black dotted curved line is produced, showing the height of the barometer, whether it is falling or rising, for how long it has been doing so, and at what rate the change is taking place—whether at the rate of one-tenth per hour, or one-tenth in twenty-four hours,—facts which could only be obtained by very frequent and regular observations from an ordinary barometer, but which are nevertheless essential to a reliable "weather forecast."

The following is an extract from the testimonial by James Glaisher, Esq., July 28, 1869:—

"The London Stereoscopic and Photographic Company's Self-Recording Aneroid Barometer:—This Instrument has been in comparison with the readings of a Standard Barometer from June 21st to the present time, and it has acted very well throughout the whole time,

"Signed, James Glaisher."

Results deduced from the Meteorological Register kept at the Royal Observatory, Greenwich, and Remarks on the Weather, *by* JAMES GLAISHER, ESQ., F.R.S., SECRETARY *of the* METEOROLOGICAL SOCIETY.

1869 Months	Mean Reading of Barometer	Temperature of Air: Highest by Day	Lowest by Night	Range in Month	Mean of all Highest	Mean of all Lowest	Mean daily Range	Mean for Month	Departure from average of 28 yrs.	Mean Temp. of the Dew Point	Mean Tension of Vapour	Weight of Vapour in a cubic ft. of Air	Mean additional Weight required for Saturation	Mean Degree of Humidity, Saturation=100	Mean Weight of a cubic foot of Air	Relative proportion of Wind: N.	E.	S.	W.	Mean Amount of Cloud 0 to 10	Rain: No. of Days it fell	Amount collected
	In.	°	°	°	°	°	°	°	°	°	In.	Grs.	Grs.		Grs.							In.
Jan. . .	29·861	55·9	26·3	29·6	46·0	36·5	9·5	41·1	+3·0	37·6	0·225	2 6	0·4	88	553	0	6	17	8	7·2	14	2·9
Feb. . .	29·808	61·6	31·7	29·9	51·8	39 7	12·1	45·3	+6·2	40·6	0·253	2 9	0·6	84	547	2	1	10	15	7·2	18	2·3
March	29·632	53·6	27·3	26·3	44·8	32·3	12·5	37·5	−4·1	32 4	0·184	2·1	0·5	83	553	14	8	4	5	7·7	17	1·4
April .	29 828	79·1	29·3	49·8	61·6	41·8	19·8	50·3	+3·4	44·6	0·295	3·4	0·8	81	542	6	8	8	8	6·1	10	1·0
May . .	29·651	70·5	33·3	37·2	60·7	43·7	17·0	50·5	−2·6	45 3	0 303	3·4	0·7	83	538	7	11	7	6	7·4	21	3·4
June. .	29·920	87·5	35·6	51·9	67·4	46·0	21·4	55·3	−3·9	48·4	0·340	3·8	1·1	78	5[illegible]8	10	5	5	10	6·3	9	1·2
July . .	29·928	90·9	49·1	41·8	77·0	54·5	22·5	64·5	+2·7	56 2	0·453	5·0	1·7	75	527	6	5	9	11	5·7	2	0·6
Aug. . .	29·968	89·0	42·1	46·9	72·3	52·4	19·9	60·8	−0·5	52·1	0·389	4·4	1·6	73	532	9	7	6	9	5·9	11	1·2
Sept. . .	29·642	80·0	41·2	38·8	68·6	52·4	16·2	59·0	+1·7	51·6	0·382	4·3	1·3	77	528	1	4	11	14	6·6	13	3·1
Oct. . .	29·867	73·9	27 9	46·0	57·5	42·0	15·5	48·9	−1·5	44·2	0·290	3·2	0·7	84	544	7	4	9	11	5·5	11	1·8
Nov. . .	29·766	58·8	26·8	32·0	49·1	37·4	11·7	43·0	−0·9	38·2	0·231	2·7	0·5	83	549	6	1	8	15	6·4	13	2·4
Dec. . .	29·619	55·8	21·3	34·5	42 0	33·4	8·6	37·9	−2·7	33·9	0·195	2·3	0·4	86	552	10	5	7	9	6·5	13	2·8
Means	29·791	71·4	32·7	38·7	58·2	42·7	15·6	49·5	+0·1	43·8	0·295	3·3	0·9	81	542	78	65	101	121	6·5	147	24·1
																Sums					Sums	

NOTE.—In column 10 the sign + implies above, and the sign — below the average.

EXPLANATION.—The cistern of the barometer is about 160 feet above the level of the sea, and its readings are coincident with those of the Royal Society's flint-glass barometer. The observations are taken daily at 9 A.M., noon, 3 P.M., and 9 P.M.; the means of these readings are corrected for diurnal ranges by the application of corrections from Mr. Glaisher's paper, in the *Philosophical Transactions*, Part I., 1848; and from the readings of the wet and dry bulb thermometers, thus corrected, the several hygrometrical deductions in columns 11 to 16 are calculated by means of Mr. Glaisher's *Hygrometrical Tables. Fourth Edition.*

The numbers in column 2 show the mean reading of the barometer every month, or the mean length of a column of mercury which balanced the whole weight of atmosphere of air and water; the numbers in column 12 show the length of a column of mercury balanced by the water alone; and if the numbers in this column be subtracted from those in column 2, the result will be the length of a column of mercury balanced by the air alone, or that reading of the barometer which would have been, had no water been mixed with the air.

[*Concluded on next page.*

The mean temperature of the air was 49°·5, being 0°·1 above the average of the preceding 28 years; the temperature of the Dew Point was 43°·8. The mean degree of humidity was 81, complete saturation being represented by 100. Rain fell on 147 days during the year. The amount of rain collected was $24\frac{1}{10}$ inches, being $1\cdot\frac{5}{10}$ below the average amount.

With the exception of the seven days from January 19th to 25th, the months of January and February were both remarkably warm. From March 1st, the excess of temperature averaged more than $5\frac{1}{2}$° daily. On March 2nd, weather of a decidedly opposite or wintry character set in and continued till the 5th of April. On the 6th a period of warm weather set in; it extended to April 29th, and the mean daily excess of temperature over the average was for these 24 days $5\frac{1}{4}$°. On the 30th of April a period of cold and warm days alternated, but the colder predominated, as the temperature averaged a defect below the average of nearly sixth-tenths of a degree daily. A much more decided cold set in on the 13th of May and continued with but trifling exceptions till the 1st day of June, being the most intense towards the end of the month, when deficiencies of daily temperature amounting to 11° and 12° were experienced. The mean temperature of the period from May 13th to June 1st was 3°·9 in defect daily, and this loss of temperature was almost wholly during the hours of the day, which were usually from 6° to 7° too low, the night hours usually being at about their average values. From June 2nd to June 8th (with the exception of the 4th day, which was cold) the period was warm, and excessively so on the 7th, on which day throughout the whole of the 24 hours there was an excess of temperature of no less than $14\frac{3}{4}$°, and the mean temperature of the six days ending June 8th was $3\frac{1}{2}$° in excess over the average daily temperature for the period. A very remarkably severe period of cold weather set in on the 10th of June and continued unchecked till the 3rd of July, some days being marked by exceedingly low temperatures; the nights as well as the days were equally cold, and the average temperatures of these days for the whole 24 hours was as large as $6\frac{3}{4}$° in defect of daily temperature.

On the 4th a warm period began, and continued till the end of the month, with very little rain, the temperature for these 28 days averaging a daily excess of 3°·4. A sudden change set in on the 1st of August, the temperature declined below its seasonable average and continued so till the 21st, with frequent rain in light showers, the average daily deficiency of temperature for the period being 2°·8; from the 22nd day there was a very warm period of a week's duration, with brilliant sunshine, and the excess of temperature daily was as large as 8°; on the 28th of August the excess of temperature was as large as 12°; on the 29th the weather changed to cloudy, bleak, and cold, and the daily deficiency of temperature averaged 3°·8 till 3rd September. On 4th September the temperature passed again above the average, and the

weather was generally warm till the end of the month, the average daily excess of temperature in the last 27 days being 3°·2.

The mean temperature of January was 41°·1, being 4°·9 higher than the average of 98 years, higher than the corresponding temperatures in 1867 by 6°·9, and in 1868 by 3°·9, but lower than in 1866, when 42°·6 was recorded.

The mean temperature of February was 45°·3, being 6°·9 higher than the average of 98 years, and with the sole exception of 1779, when the same temperature was recorded, higher than the corresponding values in any year in the period 1771-1868.

The mean temperature of March was 37°·5, or 3°·5 lower than the average of the preceding 98 years, and 6°·5 colder than 1868.

The mean temperature of April was 50°·3, being 4°·3 higher than the average of 98 years, and there have been four instances only of warmer Aprils, in the years 1779, 1821, 1844, and 1865.

The mean temperature of May was 50°·5, or 2°·1 lower than the average of 98 years, and lower than the corresponding values in 1868 by 6°·8, but higher than in 1866, when 50°·1 was recorded.

The mean temperature of June was 55°·3, being 2°·9 lower than the average of 98 years, and lower than any corresponding value since 1824, with the sole exceptions of 1830 and 1860, in the first of which years the same value was registered, and in the second 54°·8. The mean temperature of June in the year 1868 was 62°·0, being 6°·7 higher than in this year.

The mean temperature of July was 64°·5, being 3°·1 higher than the average of 98 years, lower than the corresponding temperature in 1868 by 3°·0, but higher than in any previous year as far back as 1859.

The mean temperature of August was 60°·8, being 0°·1 higher than the average of 98 years, lower than in 1868 and 1867 by 2°·8 and 1°·2 respectively, but higher than in 1866, 1865, and 1864, when 59°·4, 59° 9, and 59°·6 respectively were recorded.

The mean temperature of September was 59°·0, being 2°·5 higher than the average of 98 years. In 1868 the value recorded was 60°·5; in 1867 and 1866, 57°·6 and 56°·4 respectively.

The fall of rain was 1·1 in. in excess in January, 0·7 in. in February, 1 2 in. in May, 0·7 in. in September, slightly in November, and 0 9 in. in December; and 0·2 in. in defect in March, 0·7 in. in April, 0 9 in. in June, 2·0 in. in July, 1·2 in. in August, and 1·0 in. in October.

The mildness of the weather in January and February rendered important service to the grazier, the grass lands affording sufficient nourishment, enabling him to carry his live stock over the winter without the anticipated difficulties. At the end of February vegetation was remarkably forward, being from three to four weeks in advance of ordinary seasons. Agricultural work in the field made but little progress in these two months, owing to the land being in many places unsuitable for working, being too moist. During the greater part of March vegetation was nearly stationary and made no progress; the check was advan-

tageous. At the end of the quarter vegetation was nearly in the same state as at the end of February, excepting grass lands, pastures, and meadows, which in many places had lost the rich green and put on a brown dingy colour. Agricultural spring operations were generally in a backward state, a great deal of ploughing and sowing remained to be done.

The wintry character of the month of March checked the progress of vegetation, the fine and genial weather in April, however, caused vegetation to progress very rapidly, and at the end of the month the prospects of harvest were very good. The cold weather in May and June was altogether unfavourable, and at the end of the latter month all the cereal crops were backward, and great uncertainty prevailed as to the yield. In the southern counties alone, and even there, corn only of the early kinds were in ear and blossomed, and there seemed to be every probability that the harvest would be late.

Harvest work began in the south of England in the first week of August, it became general towards the end of the month, and was nearly completed at the end of September, excepting in the north-west of Ireland, and in the Scottish Highlands. The opinions on the produce are very conflicting in respect to yield and quality. The barley crop is spoken of as the best; the wheat and oat crops both somewhat below an average; and beans and peas are both short crops. The potato crop is spoken of as of good quality, but small, and free from disease.

The Pressure of the Atmosphere, at the height of 160 feet above the mean level of the sea, oscillated above and below the average during the first few days in January, but on the 6th a steady increase set in, and, with the exception of the 14th and 15th, remained constantly above the average till the 25th, the readings during the whole of this time being generally above 30 inches. A period of depression then ensued, which lasted till February 3rd, and on two occasions during this time the defect from average was as much as 0·8 in., the mean readings on each day being 28·9 in. From February 4th till March 7th small fluctuations occurred, the readings being alternately above and below the average in short periods; the amount of excess or defect on one occasion only being greater than 0·4 in. From the 8th to the 21st the readings were constantly below the average; an increase, which reached its maximum on the 23rd, then occurred, but on the 26th a rapid decrease set in, and the readings remained in defect during the remainder of the month. During April they were generally above the average, the only departure worth noticing being from the 15th to the 17th, when a depression took place to 29·06 in. From the 21st to the end of the month high readings were prevalent, the mean amount of excess above average for this period being as much as ·24. On the 1st of May a steady fall commenced and lasted till the 6th, the minimum recorded being 29·02 in., but on the same day an equal steady rise took place and attained its maximum (30·061 in.)

on the 13th. Decreasing readings were again recorded between the 14th and 19th, and from this time to the end of the month the readings were above and below the average several times. The barometric variations during June were very small, the greatest departures from average amounting only to −·4 and +·3 respectively. The readings were, with the sole exceptions of the 4th, 12th, 13th, 14th, and 15th, constantly in excess of the average, and usually either above or very close to 30 inches. During the month of July the readings of the barometer were, with but few exceptions, above the average. The maximum recorded was 30·24 in., the minimum 29·64 in., and the range of readings 0·60 in. The only movement worthy of notice commenced on the morning of the 23rd, the reading then being 29·92 in.; it attained its minimum (29·64 in.) on the 26th, and a steady rise then occurred which lasted till the 30th.

From the 1st to the 14th August the readings oscillated above and below the average several times, the absolute minimum, 29·39 in. (being also the absolute minimum for the month), occurred on the 9th. From the 14th to the end of the month the readings were above the average and above 30 in.

The mean readings of the barometer in the months of July and August were remarkably high, in the former month it was 29·928 in., and in the preceding 20 years there have been only two instances in the month of July of such high readings, viz., in the years 1859 and 1863, when the readings were 29·937 in. and 29·961 in. respectively. In August the reading was still higher, being 29·968 in., and the only preceding instance of the mean reading in August reaching 29·9 in. in the preceding 20 years was in 1864, when it was 29·918.

On the 1st September a fall set in, and reached its minimum (29·50 in.) on the 6th, a rise then occurred to 29·76 in. on the 7th. Decreasing readings were again recorded to 29·20 in. on the 10th, succeeded by a small increase to 29·40 in. on the 11th. A rapid fall then took place and reached its lowest point at 5h. A.M. of the 12th, 28·58 in. being recorded; and this again was followed by a steady rise to 30·08 in. on the 23rd.

During the periods of great depression in September, viz., the 9th to 20th, violent gales raged from the south-west, causing great destruction of life and property. The mean pressure of the wind on the square foot during this month was as much as 1·0 lb., the corresponding values in July and August being only 0·2 lb. On numerous occasions pressures were registered above 30 lbs. on the square foot. The mean daily horizontal movement of the air in September was 349 miles against 213 and 224 miles in July and August respectively.

The mean readings in September were very low, viz., 29·642 in., and in the preceding twenty years the only instances in the same month of lower readings were in 1841 and 1866, when the readings were 29·624 in. and 29·575 in. respectively.

Obituary.

LIST OF PERSONS EMINENT IN SCIENCE, ART, AND LITERATURE, 1869.

Professor Graham, F.R.S.—This eminent chemist was born in Glasgow in 1805. He was entered as a student in the University of Glasgow, and, in 1824, took the degree of M.A. Under Dr. Thomson, then Professor of Chemistry at the University, young Graham took his first lessons in the science of which he afterwards became a celebrated expositor. Subsequently he removed to Edinburgh, where he gained the favour and patronage of Sir John Leslie, so well known for his investigations of the phenomena of heat. Mr. Graham returned to Glasgow in 1828, and established a public laboratory there for the study and practice of chemistry. In 1830 he was nominated Andersonian Professor of Chemistry in the University. This post he held until, his fame having found an echo in the British metropolis, he was appointed to the chair of chemistry in University College. In 1837, Graham was elected a Fellow of the Royal Society, and for the space of ten years he held also the office of Chemical Examiner in Arts in the London University. He was the first President of the Chemical Society, which he was instrumental in founding (in 1841), as well as contributing to the Transactions. Of the various scientific discoveries and inquiries with which Mr. Graham's name is associated, the most remarkable and important is his elucidation of the law which governs the diffusion of gases; for his investigations and demonstrations, of which he received the Keith Prize at the hands of the Royal Society of Edinburgh, and the Gold Medal from the Royal Society of London. He was besides connected honorarily with the Institute of France and the Academies of Washington, Berlin, Munich, Turin, &c. In the year 1855, Mr. Graham received the appointment of Master of the Mint, rendered vacant by the resignation of Sir John F. W. Herschel. It is understood that the late Prince Consort was the mainspring of this upward movement in the career of the late Professor. He had previously filled the office of an assayer to the Mint, and it was imagined by his patron that his chemical knowledge would be found valuable in that establishment. This, however, was scarcely the case, as other assayers were appointed whose duty it was, and is, to submit all bullion presented for coinage, and all coin produced from it, to scientific control. It is by no means necessary, therefore, that the Master of the Mint should be a chemist. Far less is it essential that he should be an astronomer! The real qualifications for the post are a complete acquaintance with machinery and mechanical operations, mathematical knowledge, and familiarity with the art of banking and the laws of

political economy. It is questionable whether the late Master's chemical acquirements were of any real service in the money manufactory itself, however useful they may have been to the world at large. At his laboratory in the Mint, nevertheless, many experiments in physical science were no doubt conducted, and many of Mr. Graham's more recent contributions to the scientific wealth of the country were there concocted. The remodelling of the copper coinage in 1860-1, and its re-issue in the form of bronze, may be justly considered the most arduous and important work executed during the fourteen years of Mr. Graham's rule at the Royal Mint. Within the fourteen years alluded to, nearly one hundred millions of sovereigns and half-sovereigns, and some two or three hundred millions of silver coins, have been stamped into existence at Tower Hill. In the interests of truth it must be admitted that the late Master of the Mint did not seem to understand, or at least did not always practice, that gentle art which has the effect of inspiring colleagues and subordinates with an affectionate attachment to their chief. He was consequently not a popular Master, however conscientious he may have been in fulfilling the requirements of his office. Seven months previously to his decease, his brother John, who filled the post of chief coiner for a brief period, preceded Thomas Graham along that dark vale whither the footsteps of all humanity tend. It is somewhat singular to observe, that Professor Graham is the only one that has died in office since the days of Sir Isaac Newton. The preceding is from a truthful Memoir in the *Mechanics' Magazine*. Professor Graham's appointment to the Mastership of the Mint was neither judicious nor popular, notwithstanding his scientific eminence as a chemist. The Mastership will not be filled up, which course is better than reverting to the former system of making the appointment a political one. A portrait of Professor Graham, with an interesting Memoir, appeared in the *Year-Book of Facts*, 1857.

Guillaume Libri, "the man who, for this century, has won *the palm of double strength*, who has shown the greatest joint force in literature and science."—(The *Athenæum*, where it is added that "none but Leibnitz can be set up for discussion against Libri.") His principal scientific labours extend but to the age of thirty, and include his successes in mathematical research and literary investigation, his nomination to the Institute of France, and appointment to various scientific offices. While in France he published four volumes of his *History of Science in Italy*. (See a striking Memoir of Libri, in the *Athenæum*.)

Sir James Emmerson Tennent, Bart., during his residence in Ceylon, designed an exhaustive work on the social, political, religious and natural history of that magnificent island. He can scarcely be said to have accomplished all he designed; but his *Christianity in Ceylon*, published in 1850, and his more recent *Ceylon: an Account of the Island*, are admirable proofs of what

the author might have done if he had had the leisure. His account of travels in Greece, his letters from the Ægean, his historical volume on *Modern Greece*, are all creditable to him as a writer and a scholar, and Greece honoured herself by making him K.C. of the Order of Our Saviour. His *Belgium in* 1840 was less widely known; and his works on the *Copyright of Design* and on *Wine, its Use and Taxation*, addressed themselves to exclusive but highly-interested portions of the public by whom they were appreciated.—*Athenæum.*

HECTOR BERLIOZ, the celebrated French musical composer.

WILLIAM JERDAN, originator and editor of the *Literary Gazette*, which, in its day, rendered good service to popular science, especially in recording the results of Arctic discovery. Mr. Jerdan died in his 88th year. Of the Royal Literary Fund in its early days he was a zealous advocate, and by his influence greatly aided its prosperity. His kindly help was always afforded to young aspirants in literature and art, and his memory will be cherished by many whom he helped to rise to positions of honour and independence. Late in life he received a pension of 100*l.* a-year for his long services to literature.—*Times.*

PRINCIPAL JAMES DAVID FORBES, "the British De Saussure." Ill health had led him to retire, a few months before his death, from the Principalship of the United Colleges of St. Salvador and St. Leonard, at St. Andrew's. He was educated in the University of Edinburgh, and there he became Professor of Natural Philosophy in 1833. Although he was accomplished in physical science in general, he would not have been generally known had he not devoted himself to the study of glaciers and their phenomena. The publication of his *Travels through the Alps of Savoy*, of his *Norway and its Glaciers*, and of his *Occasional Papers on the Theory of Glaciers*, all marked his careful observations and his philosophical acumen. His diligence, adventurous spirit, and general accuracy of record, entitled him to the name of the British De Saussure; and no Alpine philosopher and mountaineer can feel otherwise than deeply grateful to Dr. Forbes, who, as a British Alpine pioneer, won a well-deserved fame. His theory of glaciers is briefly this:—He affirmed a glacier to be a viscous body, *i.e.*, an imperfect fluid, which is urged down slopes of a certain inclination by the mutual pressure of its parts. Viscosity was illustrated by the consistency of thick mortar, tar, or mixtures of plaster and glue. Dr. Tyndall strongly opposed this hypothesis, although it certainly accounted for most of the phenomena of glacier motion. His lectures on this subject at the Royal Institution, and his well-known volume on *The Glaciers of the Alps*, have acquainted the philosophical public with the details of his objections to Dr. Forbes, and of his own experiments and views. He applied Faraday's discovery of the property of *regelation* in fractured ice to explain the motion of glaciers, and has ably maintained his

theory, although the question cannot be regarded as entirely set at rest. These matters of theory, however, in no degree involved the merit of Dr. Forbes as a patient observer and as an able experimenter on glacial motion. His notes on the Mer de Glace alone entitle him to high credit, while his details on topography were at one time of great value. Dr. Tyndall averred that Bishop Rendu was the first who clearly stated that a glacier moved like a river, and that Dr. Forbes had not sufficiently acknowledged the priority and value of the bishop and his theory. Hence arose a controversy which became somewhat personal, but which is now forgotten by all except those who desire accurately to adjust rival claims in glacial hypotheses. We cannot forbear to add the testimony of our own Alpine experience to the worth of Dr. Forbes's books in respect of practical guidance and serviceable notes. In this respect the least of all his volumes, entitled *The Tour of Mont Blanc and Monte Rosa*, an abridgment of his larger work, commended itself to a large circle of general readers. That he was a courteous private correspondent on glacial questions we ourselves, and several known to us, would willingly testify. That he was esteemed as a natural philosopher, the Rumford and other medals which the Royal Society bestowed upon him sufficiently demonstrated. We quote this admirable *précis* from the *Athenæum*.

Bernard Bolingbroke Woodward, B.A., F.S.A., Her Majesty's Librarian at Windsor Castle, an editor and author of repute. This most efficient officer served the Queen with singular zeal, frankness, and deference. "It is not the Queen alone who knows the perfect way in which Mr. Woodward carried out the Prince's views for the improvement of the Royal Library at Windsor. He well earned the measure of esteem which Her Majesty entertained for him, and the friendly terms on which the Princesses and their brothers used to hold intercourse with him. Outside his official duties and his scholastic labours, Mr. Woodward was one of the heartiest, merriest, and best-natured of men. He as readily rendered a service as he forgot the having done it; and, though his office was perhaps the worst paid and requited in the world, Mr. Woodward was as happy as the Royal personages whom he served, and whose appreciation of him was to him guerdon sufficient."—*Athenæum*.

William Carleton—in his best time one of the most graphic of Irish novelists.

Sir J. P. Boileau, Bart.—Sir John was President of the Archæological Society of Norfolk, and Vice-President of the Society of Antiquaries, and was also a member of several other learned British and foreign societies. This family springs immediately from Charles Boileau, Lord of Castelnau, and St. Croix, lineally descended from Etienne Boileau, Governor and First Grand Provost of Paris under Louis IX. This Charles fled from France at the Revocation of the Edict of Nantes, and entered the British Army. He commanded a corps of French gentlemen at

Blenheim, under the Duke of Marlborough. He was father of Simeon Boileau, Esq., a merchant, of Dublin, the grandfather of the Baronet just deceased.

ABRAHAM COOPER, the oldest Royal Academician, formerly famous for his horse and battle pieces. Mr. Cooper survived nearly all the men of his year in the Royal Academy Exhibition of 1812, so long ago is it since his first work, "The Farrier's Shop," was shown to the public between two very famous paintings, Turner's *Oxford from the Abingdon Road*, and Stothard's *Canace*. He died in his eighty-second year. He had probably exhibited a greater number of pictures than any other Royal Academician.

COLONEL CHARLES VALLANCEY, Engineer and Antiquary. He published the *Field Engineer*, a treatise on Stone-cutting, and one on Tanning, and other subjects. Next succeeded a military survey of Ireland, which not only received the approbation of George III., but also was rewarded with pecuniary favour. In 1774 began that work with which Vallancey's name is more intimately connected, entitled, *Collectanea de Rebus Hibernicis*. This work was continued occasionally, and extended over a number of years. Fourteen numbers of this publication appeared, forming about five octavo volumes. In 1772 or 1773 Vallancey published an *Irish Grammar of the Iberno-Celtic Language*. This work was reprinted in 1782, with additional matter.—*Builder*.

GEORGE SMITH, architect, F.S.A.

ORLANDO JEWITT, Architectural Engraver. His works did not attract much attention till he left Derby, many years ago, to live at Headington, near Oxford. Here he was busily engaged in the production of the Illustrations for the *Glossary of Architecture* and other books, for Mr. Parker, the archæologist and publisher, of Oxford. The whole of the drawings on wood for the *Glossary* were made by Mr. Jewitt's own hand, as well as many of the original sketches from which the drawings were taken. Amongst his later works are the illustrations to Mr. Scott's *Memorials of Westminster Abbey*, and Mr. Street's books on Venice and Spain. The majority of the drawings in the latter books were made on wood (as well as engraved) by Mr. Jewitt himself, or by artists in his employ; but the best of all is his last piece of work, viz., a series of most elaborate and highly-finished illustrations for a forthcoming work on *Ancient Rome*, by Mr. Parker. These illustrations have never been exceeded for beauty and minute accuracy of detail, and will remain a lasting monument of Mr. Jewitt's excellence as an artist and engraver.—*Builder*.

THOMAS CRESWICK, R.A., the distinguished landscape-painter: his pictures of English scenery have rarely been excelled.

SIR WILLIAM CLAY, BART., well-known in Financial Literature.

PETER MARK ROGET, M.D., F.R.S., aged 91. He was the son of the Rev. John Roget, a descendant of a Swiss family, and minister of one of the Swiss churches in London; his mother

being a sister of the late Sir Samuel Romilly. Having chosen medicine as his profession, he proceeded to Edinburgh, where he completed the usual course of medical studies at the University. He took the degree of Doctor of Medicine in June, 1798, before he was twenty years of age. He afterwards attended the London Medical Schools as the pupil of Baillie, Cruikshank, Wilson, Heberden, and Horne. When the Continent became open to English travellers by the conclusion of the Peace of Amiens, Dr. Roget went to Paris and Geneva, where he remained two years. On the abrupt resumption of hostilities between France and England, Buonaparte suddenly resorted to the unjustifiable measure of seizing on all Englishmen who happened to be within the French territory, and Dr. Roget was among the number of the *détenus*. After being retained as a prisoner for two months he obtained his liberty by means of a passport which was granted to him in virtue of the privileges belonging to him as the son of a citizen of Geneva. Returning to England, he became the travelling attendant of the Marquis of Lansdowne. On the termination of this engagement he started in practice in Manchester, and soon obtained the appointment of physician to the Infirmary, and he resided there four years. In 1808, he quitted this place for London, where he was admitted a licentiate of the College of Physicians. In 1811, he was chosen one of the secretaries of the Medical and Chirurgical Society of London, and in 1829 and 1830 was elected president. To the *Transactions* of the Society he contributed some papers. In 1814, a valuable paper contributed by him to the Royal Society obtained for him the fellowship of that Institution. In 1820, and for many subsequent years, he held the appointment of Physician to the Spanish Embassy. In November, 1827, Dr. Roget was appointed Senior Secretary of the Royal Society. In 1833, he wrote his *Bridgwater Treatise on Animal and Vegetable Physiology*. To the general public Dr. Roget is deservedly well-known by his admirable *Thesaurus of English Words and Phrases*, a twentieth edition of which he was engaged on at his death. The various appointments conferred on Dr. Roget by the Crown and public bodies attest the estimation in which he was held. An interesting and extended life of Dr. Roget is given in *Pettigrew's Medical Portrait Gallery*.—*Times*.

Sir Charles Wentworth Dilke, Bart., proprietor of the *Athenæum* Journal, and intimately associated for many years past with International Exhibitions, the Royal Horticultural Society, and the Society of Arts. The deceased baronet left two sons,—namely, the present member for Chelsea, and Mr. Ashton Dilke, who had accompanied his father to St. Petersburg, where his death took place.

M. Chalons d'Argé, for many years Keeper of the Records des Beaux-Arts de la Maison de l'Empereur. He was author of a few romances and dramas, none of which were particularly successful, and of a critical history of the *Théâtres de Paris*. He was

Secretary-General of the Odéon for some years. In 1829, he founded the *Journal des Comédiens*, which, with a changed title, is still in existence.

Sir Henry Ellis, principal Librarian of the British Museum, in his 92nd year. He was appointed to that post in 1827, and was for many years Secretary of the Society of Antiquaries. In middle life he was indefatigable as an author. Among the most valuable of his publications are his *Original Letters Illustrative of English History*, with Notes and Illustrations, mainly from the autograph originals in the British Museum, the State Paper Office, and other sources. Sir Henry Ellis was also the responsible editor of an enlarged edition of Dugdale's *Monasticon Anglicanum*, in several volumes folio. He also was the author of the General Introduction to *Domesday Book*. Only a few weeks ago we found him assiduously examining the accounts of the Literary Fund, and heard from his lips many stories of long, long ago. Directly after this, the fall of a stack of chimneys into the room where he was sitting gave a shock to his system, and there is reason to fear expedited the event we deplore.—*Builder*.

Dr. John Martin, a veteran both in literature and science. So far back as 1817 he was the editor of Mariner's *Tonga Islands*, a work which has been always held in high estimation. Dr. Martin laid down meteorological charts representing the varying aspect of months, seasons, and years from daily observation. He also made careful observation with reference to ozone, as well as on the characteristics and circumstances affecting cholera and yellow fever.

J. C. Bakewell, son of the eminent geologist, well known in the scientific world. Mr. Bakewell was the author of *The Natural Evidences of a Future Life*, *Philosophical Conversations*, *Electric Science*, and other works of merit.

Professor Jukes, M.A., F.R.S., Director of Her Majesty's Geological Survey of Ireland, and Professor of Geology to the Royal College of Science. In 1839, he was appointed Geological Surveyor of the colony of Newfoundland, and returned to England in 1840. In January, 1842, he was appointed by the Admiralty naturalist to Her Majesty's ship *Fly*, which was then about to proceed on a surveying and exploring voyage to the shores of Australia and New Guinea, under the command of Captain F. P. Blackwood, R.N. In September, 1846, he was appointed to a post on the Geological Survey of the United Kingdom under the late Sir H. D. De la Beche, the Director-General. In November, 1850, he was transferred to Ireland as local director of that branch of the survey, and on the establishment of scientific lectureships in the Museum of Irish Industry under Sir Robert Kane, M.D., in 1854, he was also appointed Lecturer on Geology to that institution. He has published many useful geological works, among which may be mentioned *Sketch of the Physical Structure of Australia*; *Popular Physical Geology*;

The Student's Manual of Geology; *Geology of the South Staffordshire Coal-field*, as well as numerous papers on geological subjects in the journals of the geological societies and in periodicals. He was a Fellow of the Royal and other learned societies.—*Times*.

The Rev. William Clark, M.D., Professor of Anatomy in the University of Cambridge. The deceased professor was entered at Trinity College nearly seventy years ago, in company with Professor Sedgwick, the late Lord Langdale, and Dr. Blomfield, formerly Bishop of London. He graduated in the year 1808, and with such distinction that he was elected to a Trinity fellowship in due course. In the year 1817 he became professor of anatomy, and he discharged the duties of this professorship for nearly half a century.

Dr. Bryson, M.D., F.R.S., Honorary Physician to the Queen, and lately director-general of the navy medical department. The deceased gentleman began his medical studies in Edinburgh. He also studied in Glasgow, where he took his M.D. degree, and was admitted a member of the Faculty of Physicians and Surgeons, Glasgow. He was also a Fellow of the Royal College of Physicians, London. Dr. Bryson has seen a great deal of active service, and is well known as the author of works on *The Climate and Diseases of the African Station*; *Epidemics of Sierra Leone*; *Statistical Reports on the Health of the Navy*, &c.

David Napier, of Glenshellish, Argyleshire, aged 79. Along with his relative, Mr. Robert Napier, of Shandon, he laid the foundation of the world-wide fame of the firm of Napier and Sons as shipbuilders and marine engineers. As far back as 1818 he was the first to introduce British coasting steamers, as well as steam packets for our Post-office service. He was also first to establish a regular steam communication between Greenock and Belfast. Mr. Napier invented the steeple-engine, which was a great improvement on the side lever, as occupying much less space.—*Builder*.

Professor Conington (Latin, in the University of Oxford), one of the most learned of modern critical scholars. During a short life he did more for classical and critical literature than most of his contemporaries; and his name is honoured not only in his own country, but elsewhere in Europe, especially in Germany. In 1848 he published *The Agamemnon of Æschylus*, with notes and a translation into English verse; in 1850 he edited Dr. Magin's *Homeric Ballads*; in 1854 he was elected to the newly-founded Professorship of Latin at Oxford; in 1855 he delivered (and had printed) his *Inaugural Lecture on the Academical Study of Latin*; in 1857 he issued an edition of the *Choephoroi of Æschylus, with Notes*; in 1858, he added to the *Bibliotheca Classica* the works of Virgil, with an English commentary; in 1863 he published a translation of *The Odes of Horace*; and in 1867 a very spirited rendering of *The Æneid* into English verse, in a metre similar to that adopted by Sir Walter Scott in "The Lady of the Lake." The Professor, who

was only forty-four years of age, was one of the most learned of modern critical scholars, and had crowded the work of many years into a short and brilliant life.—*Illustrated London News*.

THE REV. JOHN WEBB, M.A., the well-known antiquary and scholar. Mr. Webb had attained his ninety-third year, having been born in the year 1776. From boyhood he showed a strong love for history and antiquities, especially for those of his own country; and he used to talk in after-life of the pleasures of a tall black-letter folio copy of Hollingshed's *Chronicles* which he had found in the library of St. Paul's School. One of his earliest friends was Sir Henry Ellis, the late Librarian of the British Museum. They knew each other as boys; throughout their long lives they maintained a constant intimacy, fostered by a similarity in literary pursuits, and Mr. Webb survived his old friend but a few weeks.—*Athenæum*.

JOHN RICHARD WALBRAN, F.S.A., Corresponding Member for the Society of Antiquaries of Scotland, honorary member of the Society of Antiquaries of Newcastle-on-Tyne, and local secretary of the Archæological Institute of Great Britain and Ireland. His earliest works consisted of Guides to the abbeys, castles, and other places of interest in Great Britain. These were succeeded by *On an Oath taken by Members of the Parliament of Scotland from Aug.* 10, 1641 *to* 1649, and the *History of Ripon*. His last work was *Memorials of Fountains*, for the Surtees Society, of which only one volume was published.—*Illustrated London News*.

JOHN BRUCE, F.S.A., eminent antiquarian writer.

JAMES BASIRE, the last of the line of the celebrated engravers of that name. For upwards of 120 years the name and family have been intimately associated with the Royal Society, the Antiquaries, and other societies. James Basire, the grandfather of the deceased, illustrated the *Vestuta Monumenta* for the Society of Antiquaries; and also Mr. Gough's *Sepulchral Monuments*.

GENERAL JOMINI, the well-known writer on military tactics, at the age of ninety.

PROF. HUBER, at Wernigerode. His book on the English Universities, translated by Mr. Frank Newman in 1843, is still the best book of its kind. He resigned his Professorship of Literature in Berlin to pursue social science in general, and co-operation in particular; and his cheery face was well known at the co-operative meetings of the Christian Socialists, the Rochdale Pioneers, &c. He has written and printed many helpful tracts and books on Co-operation, of which he was one of the acknowledged leaders in Germany.—*Athenæum*.

DR. WADDINGTON, who was a medallist so long ago as the comet year, 1811: he went to Greece, Egypt, and Ethiopia early in the century, soon after Byron had made the Levant a place of pilgrimage. *A Visit to Ethiopia, A Visit to Greece*, published in 1825, *The Present Condition and Prospects of the Greek Church*, all testified to his careful observation of the East. Later in life he wrote a *History of the Church*, and a *History of the Reforma-*

tion on the Continent. After his appointment to the Deanery of Durham he gave up writing for the public.—*Athenæum.*

MR. BERGENROTH, the distinguished *littérateur.* He was at Simancas, the field of his useful and important labours, when he was attacked by fever, and though he left for Madrid, he gradually succumbed. Mr. Bergenroth was a scholar, a traveller, and a gentleman; a man of good family and connections, and of very wide and sound accomplishments. His *Calendars of State Papers* will long preserve his memory in the grateful minds of literary and historical students.

FREDERICK HERING, architect. Mr. Hering, who belonged to a family of artists, was an accomplished and amiable man, but seems to have obtained few opportunities to distinguish himself in his profession. The elaborate shop-front at the corner of the Quadrant and Regent's-circus he designed for Messrs. Swan and Edgar, some thirty years ago.

ARTHUR ASHPITEL, F.S.A., architect and archæologist. His contributions have been frequent and valuable to the Society of Antiquaries, the Archæological Association, and to the Dictionary of the Architectural Publication Society. In connection with the British Archæological Association he contributed papers on the Cathedrals of Worcester, Chester, Lincoln, Rochester, and others. He also edited an edition of Nicholson's *Carpentry,* and quite lately edited, under the title *A Treatise on Architecture,* papers on Architecture and the Arts of Construction, originally published in the *Encyclopædia Britannica.* Mr. Ashpitel took a very active interest in the affairs of the Royal Institute of Architects; and he bequeathed the greater part of his rare and valuable books, and his collection of antique and Etruscan vases, brought by him from Italy, to the Society of Antiquaries.—*Builder.*

EDWARD GOODALL, engraver, famous for his reproductions of Turner's middle and later styles, especially *Caligula's Bridge, Cologne,* and *Tivoli,* also for Rogers' *Italy* and *Poems,* with Turner's *Southern Coast,* and an immense number of small works. Mr. Goodall died at seventy-six years of age, and was the father of Mr. F. Goodall, R.A.

WILLIAM BRADBURY, of the eminent printing and publishing firm of Bradbury and Evans.

GENERAL PERRONET THOMPSON, the political, literary, and mathematical veteran, at the age of eighty-six.

SIR EDWARD CUNARD, Bart. He succeeded his father as second Baronet: he lived but a few years to enjoy the honour and fulfil the duties devolving upon him as the head of the great steam-ship company which bears the family name. The funeral of Sir Edward Cunard was solemnised at New York, and his remains were laid in Trinity churchyard, New York city, by the side of those of his wife. It is now more than thirty years since the Cunard Company was founded by Sir Samuel Cunard; Mr. George Burns, of Glasgow; and the late Mr. David M'Iver.

Since the company first undertook to bridge the Atlantic with their steamers, every sea on the face of the globe has become crowded with steam-ships of beautiful construction and amazing power.—*Illustrated London News.*

William Dargan, the originator of the Great Exhibition in Ireland. When he died, Ireland was so sensible of having lost the most practical of her benefactors, that a subscription was immediately started for the benefit of his widow, who was reduced from a condition of affluence to one of penury. Mr. Dargan's biographer will have the unpleasant task of recording that the subscription utterly failed, and that the English Government was asked to furnish the means which Irishmen did not care to contribute.—*Athenæum.*

Peter Cunningham, the well-known antiquarian writer and art critic, sometime Fellow of the Society of Antiquaries. He was a son of Allan Cunningham, the poet, and at the age of 18, was appointed to a clerkship in the Audit Office, where he rose to become one of the heads of his department. The appearance of his early works led to a jealous objection being made to Mr. Cunningham's literary avocations interfering with the discharge of his official duties; but we happen to have seen a letter written by Sir Robert Peel (through whose interest he was appointed), highly approving of Mr. Cunningham's exertions in literature, and regarding them subject only to the reverse of the above imputation. Mr. Cunningham produced several works on literary and artistic subjects, historical, biographical, and antiquarian, and he was well known as the annotator of the handsome library edition of *Horace Walpole's Letters*, projected and published in nine octavo volumes, by Mr. Richard Bentley, New Burlington treet; but the work by which he is most popularly known, is his *Handbook of London, Past and Present*, written for Mr. Murray, published in two vols., 1849, and in one vol., 1850; a work ranked next to that of honest John Stow, and of unimpeached accuracy, displaying a great knowledge of our earlier dramatists and topographers. Mr. Cunningham contributed to the "Literary Gossip" of the *Athenæum*, and for some years a pleasant column of "Town and Table Talk," to the *Illustrated London News*, for which his wide acquaintance with the anecdote biography, from the reign of Queen Anne down to our own time, especially fitted him: indeed, in this sort of contribution he has scarcely been equalled. After retirement to St. Alban's, his literary contributions were chiefly confined to the *Builder*. Mr. Cunningham was extensively esteemed for his social qualities, and his piquant humour: though unkindness has been ascribed to him as a critic, it arose from his regard for truth being mistaken as severity, and his contempt for empty pretension being occasionally misunderstood.

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